# AIR&SPACE

Smithsonian · April/May 1989

An aerial camera captures Kenya

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| 1366665. Finnish | 1429224. Latin | |
| 1232669. French | 1232750. Norwegian | 1363316. Thai |
| 1232677. German | 1232768. Persian | 1232842. Turkish |
| 1232685. Greek | 1300375. Polish | 1232859. Vietnamese |
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April/May 1989
Volume 4, Number 1

# AIR&SPACE
Smithsonian

## Contents





KLAUS-PETER STEITZ



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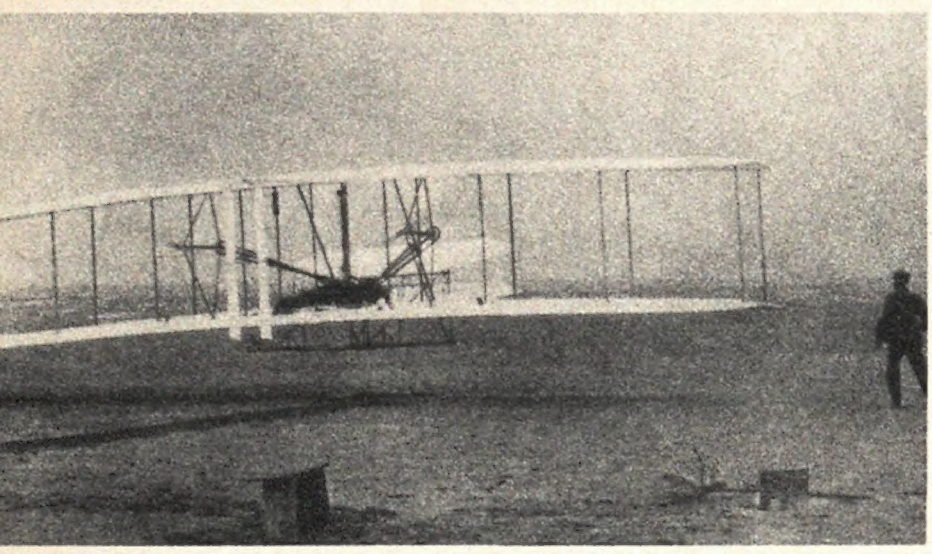
Cover: *Baron Wolman's aerial photograph of Kenya is a sample from a work in progress.*

WRIGHT FLYER (1903)



SPITFIRE (1936)

SOPWITH CAMEL (19

MESSERSCHMITT Bf. 109E (1939)

DOUGLAS DC-3 (1935)

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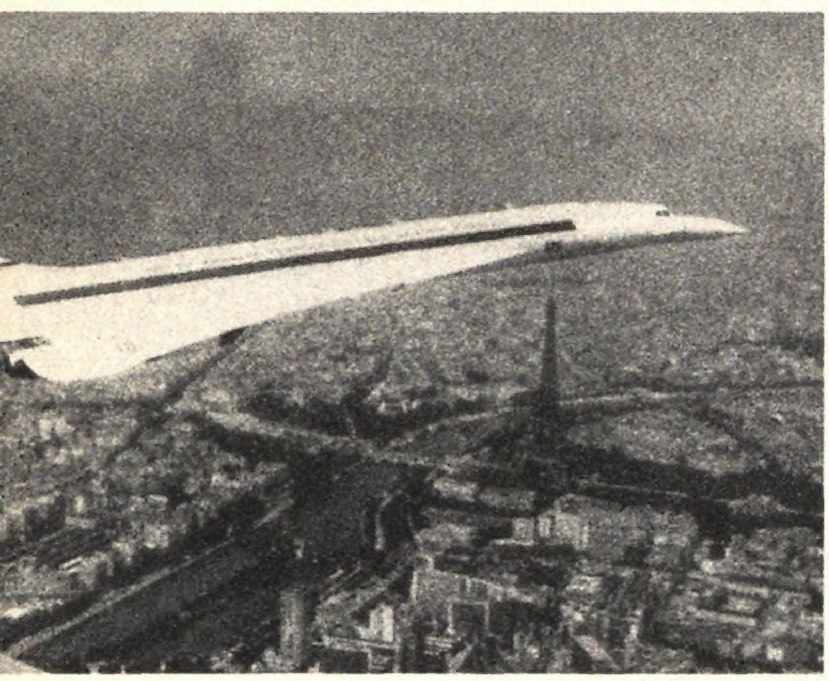
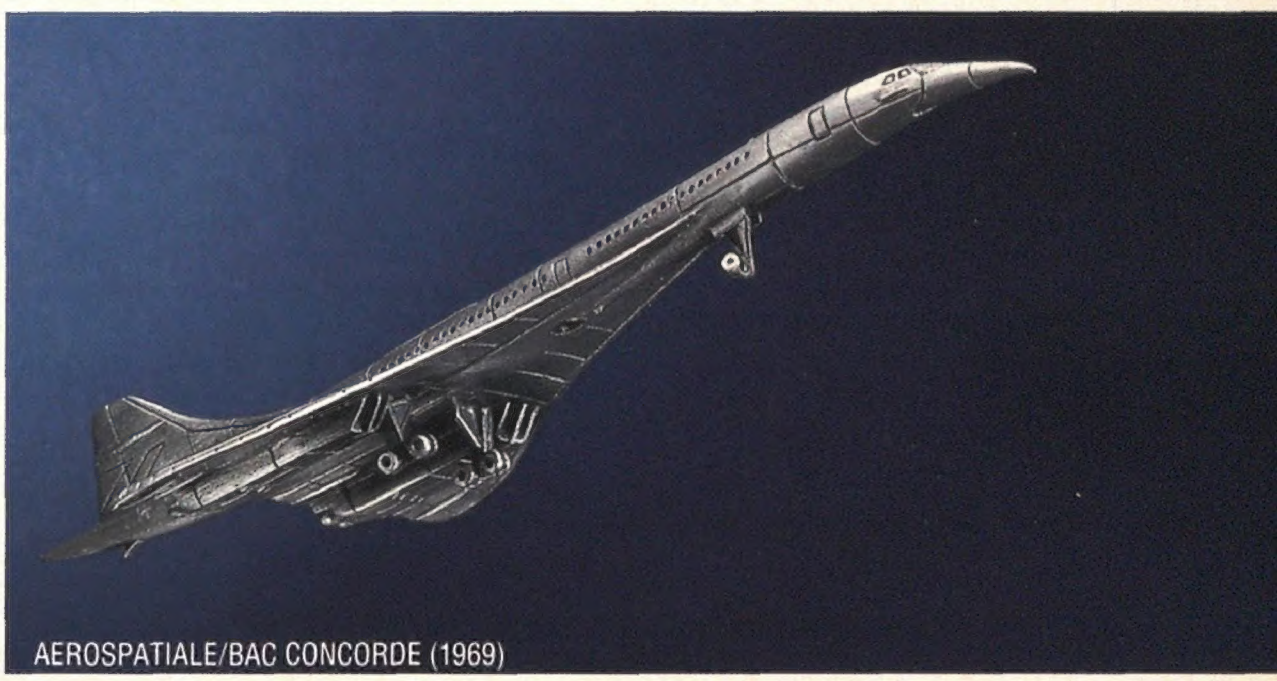
GRUMMAN F-14 TOMCAT (1972)

BOEING B-17 FLYING FORTRESS (1943)





AEROSPATIALE/BAC CONCORDE (1969)

Sculptures shown actual size. Average wingspan: 3.25".

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## The History of Aviation in Pewter

# Grounded—With Good Cause

There is no question that people love to see old airplanes fly. Huge crowds turn out for planned flybys wherever they take place. The sound of those throbbing engines alone—so different from what we usually hear today—thrills audiences. And the sight of a vintage aircraft in the sky can turn any head, often moving the person watching to reflect upon the past with fondness and wonderment.

It's not surprising, then, that we at the National Air and Space Museum are often asked why we don't fly the aircraft in our collection. It's a good question, but one with a fairly straightforward answer.

To begin with, the ability of any given aircraft in the collection to fly is already a documented fact. Almost all of our aircraft have led long and distinguished flying careers before being retired to the Museum. (There are a few notable non-fliers, such as the unsuccessful but historically significant 1903 Langley Aerodrome and the mockup of the forward-swept-wing X-29 going on display this May in the Museum's new Beyond the Limits Gallery.)

While the sight of these rare birds in the air would doubtless be a joy for today's generations, the Museum's collection has a more far-reaching purpose. The objective of the Museum is to preserve historic and technologically significant aircraft for both today's generations *and* those in the years to come.

Flying these aircraft would defeat this purpose in several ways. Making an aged airframe safe for flight, for example, could require some structural reinforcing. No one would care to fly a World War II fighter that had original 45-year-old, age-hardened flexible tubing and hydraulic piston cups. These would have to be replaced with new parts—probably of different materials. Certain instruments would also have to be updated and changed in order to be reliable. Radio tubes for old equipment are scarce, if available at all, and certainly less reliable than today's electronics. The engines, too, would have to remain in a functional condition, guaranteeing their gradual and continual deterioration. With so thorough an overhaul, the Museum's goal of preserving the technology would be lost.

Instead, the Museum approaches all of its preservation and restoration projects with the intent of making each part capable of surviving for 300 to 400 years—except for certain materials such as rubber, fabrics, and exterior painted surfaces. For example, we restore engines with synthetic preservative materials rather than organic and mineral lubricants. If we ever needed to run these engines—say 200 years from now—for study purposes, the preservatives would be removed and the engines made operational again. By that time, the running of an internal combustion engine might be quite a rare event. Because we cannot accurately judge today the significance our artifacts will have in the future, we must do our best to preserve what we can for the day when their true value will become known.

Aside from losing the original technology, there's also the substantial danger of completely losing the airplane itself. Vintage aircraft that fly continue to be destroyed in operational accidents. It is far too common to read of the loss of a World War II fighter or bomber during a flight demonstration or landing mishap. Whether the cause is pilot error or material failure, the result is the same: the number of these vanishing aircraft is reduced. Such risks are too great to be taken with the National Air and Space Museum's aircraft. By not flying—and not wrecking—our aircraft, we can help ensure that they may someday be the sole surviving representatives of their particular types. All others will have served a purpose by having been seen at other museums or restored for flying exhibitions. But barring unforeseen disasters and circumstances, it is our hope that the aircraft in the National Air and Space Museum will be able to outlast them all and go on to delight and inform again and again—far beyond their normal lifespans.

*—Robert C. Mikesh is senior curator of the National Air and Space Museum's aeronautics department.*

AIR&SPACE
Smithsonian

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# Letters

## Hail to the BUFF

Being a B-52 crew chief assigned to Griffiss, I was delighted to read "The Once and Future Bomber" (February/March 1989). It's a very demanding job maintaining these beasts, and working around the clock in all kinds of weather makes the job even more difficult. It takes a combined effort of the men and women of the 416th maintenance complex to keep them flying. Watching our bombers take off after we've worked a long, cold night gives us a feeling of pride and satisfaction.

Given the choice of flying commercial or on my BUFF, well, I don't mind wearing earplugs, a parachute, and a helmet. I'll fly on my bomber anytime.
*Michael A. Pupillo*
Taberg, New York

## Real Animals

"If These Bags Could Speak . . . " (February/March 1989) was a joy and partly made up for past experiences with lost bags. However, Lenny Melnick's comment on American Tourister's commercial missed the point. It wasn't intended to represent what goes on back there. American Tourister knew that if real baggage handlers were used, the bag would have failed.
*Bino Angonese*
Lincolnshire, Illinois

## Move This Mountain

I enjoyed "Get 'em Up, Scout!" in the February/March 1989 issue. It brought back memories of watching rockets going up from Vandenberg. They were a common sight to residents of the Santa Ynez valley, a few dozen miles east of the launch site. I remember many times taking a minute out from high school PE or weekend basketball to watch a rocket rise. No doubt some of these were Scouts.

At that time I lived a good ways to the west of the Sierra Nevada Range. I now live west of Mt. Hood, in Oregon. I certainly was surprised to learn from the article that I still live west of the Sierra Nevada!
*Brian Diehm*
Lake Oswego, Oregon

*Editors' reply: Mt. Hood and Mt. Shasta are in the Cascade Range, not, as we reported, the Sierra Nevadas.*

## Setting the Record Straight

Since you are the premier communication between the world of aerospace and the American public, and as a tribute to the men and women who design, build, fly, and maintain them, please stop calling the C/KC-135 fleet of aircraft as "militarized" or "modified" Boeing 707s. The 135s are either Boeing 717s or Boeing 739s. They differ significantly in structures and systems from their 707 cousins. The KC-135 was in production before the civilian 707 was contracted.

The first 135 was delivered in 1956 and is still flying as an EC-135K at Tinker Air Force Base in Oklahoma. The rest of the KC-135s are scheduled to be fully operational until at least the year 2020. The youngest 135 will then be 55 years old.

The 135 is easily the most diversely modified single airframe in history, with 37 different model-designated series. It is flown by all of the operational commands of the U.S. Air Force, U.S. Navy, and French Air Force, as well as NASA.
*Thomas Solinski*
Oklahoma City, Oklahoma

## Space History

In "Get 'em Up, Scout!" (February/March 1989), Joseph Harriss indicates that "Italy became [in 1964] the third country to venture into space." It is not clear whether Mr. Harriss means the third country, other than the U.S. or the U.S.S.R., to physically launch a satellite, or the third country to start a space program. In either case, it should be pointed out that Canada designed

and built Alouette 1, launched from Vandenberg Air Force Base in California on September 29, 1962.

Alouette carried several payloads, including a topside ionospheric sounder and a cosmic noise receiver. An exceptional mission, it lasted 10 years and established the standards apparent in Canada's space program today. Like the Scout team and the Italians, we are proud of our achievements early in the Space Age.

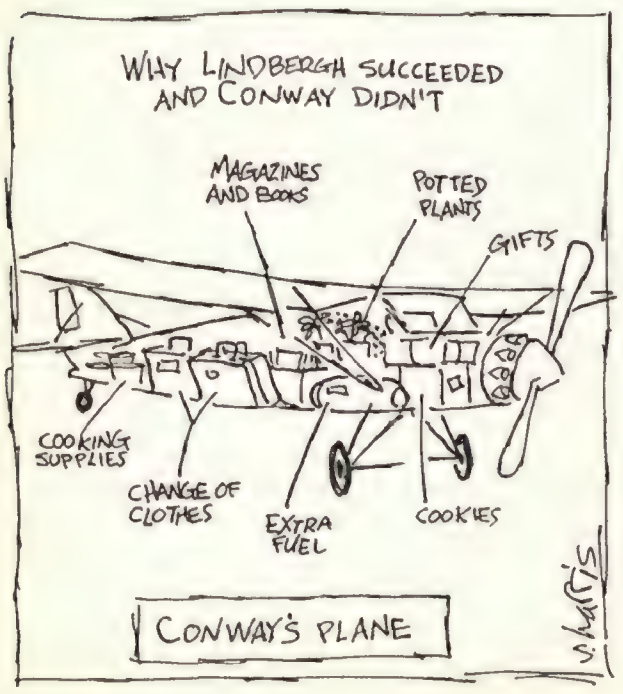
Incidentally, Alouette 1 weighed about 320 pounds and was launched by a Thor-Agena B into a high-inclination, 600-mile orbit. The Scout would have been a cheaper launch vehicle, but it was a bit small.
*Craig Maskell*
Ottawa, Canada

*Editors' reply: Alouette was part of an international study. In 1972 Canada did become the first operator of domestic satellites.*

### Right Man, Wrong Airplane

I found the first photograph in the December 1988/January 1989 Calendar most interesting. I was very pleased to see Mr. Curtiss' achievement in the history of seaplane development recognized, but why was a photograph used showing the floats of the 1914 reconstruction of the Langley Aerodrome?
*Lindsley A. Dunn*
*Glenn H. Curtiss Museum of Local History*
Hammondsport, New York

*Editors' reply: The airplane in the photograph is, in fact, Curtiss' modification and reconstruction of Langley's Aerodrome, not the seaplane that Curtiss flew on January 26, 1911.*




### B-50 or B-29?

I thoroughly enjoyed "Bringing Up Betsy" (December 1988/January 1989). However, you identified the aircraft on page 82 as a B-50. Unless my eyes deceive me, the aircraft is a B-29. Am I correct?
*David G. Ford*
Victoria, Texas

*Editors' reply: The aircraft is a Boeing B-50, which was a later development of the B-29 Superfortress.*

### Nuclear Reaction

Bill Wagstaff's article ("A Spaceship Named Orion," October/November 1988) is far from objective toward nuclear-powered spacecraft. His message, that research in this area has been all but abandoned except for the efforts of a few rebels here and there, is entirely incorrect. If the U.S. is ever going to have a real space program again, certainly it's going to be with the colonization of the moon and Mars. Nuclear fission and fusion power are way ahead of the pack as a feasible energy source for traveling those distances and supplying electricity to such colonies.

The next time you have an editorial such as Mr. Wagstaff's, please label it as such.
*Ron Taylor*
Livermore, California

### Lost Aircraft

I read with great interest "Frozen Assets" (Soundings) in the December 1988/January 1989 issue. I have been tracking the exploits of this group since 1981. I read an article that appeared years ago entitled "The Saga of My Gal Sal," the story of a B-17 that was forced down during a snowstorm on Greenland's west coast in 1942. It included interviews with the surviving crew and what they had done since the war.

I am interested in any comments from readers as to any expeditions to salvage or explore the B-17. I would also like to hear from any member of the crew.
*Eddie Lewis*
Huntsville, Alabama

Air & Space/Smithsonian *welcomes comments from readers. Letters must be signed and may be edited for publication. Address letters to* Air & Space/Smithsonian, *AIAA Bldg., 370 L'Enfant Promenade SW, 10th Floor, Washington, DC 20024.*

# Honda's Stealthy Scoop

AMERICAN HONDA MOTOR COMPANY

South Dakota's Ellsworth Air Force Base, just east of Rapid City, is a B-1B bomber base, but it also has the first B-2 Stealth bomber. Well, sort of. This B-2 was built for American Honda Motor Company and is not even roadworthy, much less airworthy.

The homebuilt B-2, the brainchild of Rubin Postaer and Associates for a Honda CRX advertising campaign, debuted on TV and in national magazines weeks before the Air Force unveiled its version late last November. "The [ad] copy almost wrote itself from Air Force quotes," says Bob Coburn, the writer who helped dream up the idea. "We said, 'Shrouded in secrecy for years, the Stealth bomber will soon be introduced to the public. For the record, we introduced ours first.' "

Honda's B-2, with its 100-foot wingspan, is about three-fifths the size of the real B-2. Jon Ward, who builds mechanical props for the film industry, assembled it for about $200,000. "We dug up the old Northrop Flying Wing design," he says, "took part of that and part of the drawings that leaked out. We got real close." Close enough, says Postaer account supervisor Ron MacMillan, that "some people thought we had a mole in the Pentagon that gave us the plans. Or they wanted to know how we negotiated getting that plane from the Air Force."

Ward, who lives next door to Southern California's Agua Dulce Airpark, and a crew of 11 assembled the prop in Ward's front yard in one month, using 16-gauge sheet steel, an old Corvette rear window, and landing gear from a Convair 440. Ward kept it under wraps until Postaer was ready to claim it, and then unveiled it, much to the bemusement of pilots landing at Agua Dulce. "Naturally," says Ward "they came crawling over the fence and said, 'What the hell is *that?*' "

The seven-piece model was disassembled and sent on three trailers to the Dade-Collier airport west of Miami, where the ad was filmed. Mission accomplished, "we had no idea of what we were going to do with this 20,000-pound prop," says MacMillan. "We kind of fell in love with it . . . . I hated the idea of it becoming an alligator nest."

Both Honda and Postaer put out feelers. One of the more original responses, says Eric Conn, Honda's national automobile

advertising manager, was from a gunnery sergeant who wanted to use it as a target.

Then Lieutenant Colonel Robert Klawon of Ellsworth Air Force Base charged in like the cavalry. He arranged for Honda to donate its Stealth to the South Dakota Air and Space Museum at Ellsworth, and even got Honda to pick up all transport charges. The model will make its second debut during the Ellsworth open house this July.

Now that all concerned parties are happy with the outcome of the ad campaign—save one gunnery sergeant—Coburn can look back on the ad agency's scoop with pride. "It was meant to be humorous, comparing this little car with the Stealth. I'm not sure what Northrop thought of it. I think ours looked better."

*—Bob McCafferty*

**Update**

The Immigration and Naturalization Service has proposed digging a four-mile ditch from Tijuana Airport to the Otay Mesa border crossing to discourage illegal border crossings by motor vehicle ("Holding the Line," December 1988/January 1989). INS officials say the 14-foot-wide ditch will lighten the load on Border Patrol agents, who cannot keep pace with the large number of immigrants who drive across the border between midnight and 3 a.m.

## *Sir Thomas*

"Some people like to call me an airplane designer," said the tall, elderly gentleman, leaning forward on the dining room chair for emphasis. "But frankly, we had no idea how to design airplanes for war in 1914. So the only thing we could do was wait until a pilot came back from a dogfight and say there is too much this or too little that, and we would fiddle with the machine and try to change it a bit. Not very scientific, but then nobody else was much better."

Sir Thomas Octave Murdoch Sopwith paused, and his wife gently chided him. "Now, Tommy, don't let's get off on those old airplanes again." He scowled under enormous gray eyebrows and tugged at his imposing nose, then surrendered the floor to the guests gathered at the luncheon table.

It was a beautiful autumn afternoon in 1977. Sir Thomas was 90 years old and clearly relished recalling how little was known about airplanes during World War I and how surprisingly successful some of them were. Though the layman knows Sopwith for the Pup and Camel, Sir Thomas designed and built dozens of other fighters, racers, tourers, and trainers.

JOHN FRICKER

As the table was cleared, Sir Thomas' glance was drawn beyond the leaded windows of the grand manor house in southern England in which he and Lady Sopwith had lived for the last half-century. "The view is straight north, across the Salisbury Plain," he said. "You can see for 30 miles or more on a clear day. It's a glorious sight."

A box of huge black cigars was passed around the table, and Sir Thomas ceremoniously lit one in a cloud of smoke. After a few moments he passed it to Lady Sopwith, who puffed appreciatively before returning it in a rite they had clearly enjoyed many times before. "We're very economical with our cigars around here," she laughed.

At age 18 Sopwith was piloting balloons, and by 22 he had taught himself to fly. He held pilot license number 31 in the United Kingdom and proudly displayed that number on his automobile license plate. Before long he was winning international races in airplanes of his own making. When war broke out in 1914 he started building military aircraft based on his racing designs, and the Sopwith company produced over 12,000 biplanes and triplanes during the war.

When World War I ended Sopwith promptly liquidated the business, amid a few accusations of profiteering. He stared down his critics and opened a new company named after his test pilot, Australian H.G. "Harry" Hawker. "We couldn't very well start a new company with the same name as before," recalled Sopwith, "and Harry had stuck with me after the old factory closed, so we simply called it Hawker. We had capital of 20,000 quid and did quite well." The Hawker Hurricane kept the Luftwaffe at bay during World War II until the faster and more advanced Supermarine Spitfire arrived.

"You see that cup on the mantel?" Sopwith asked, returning to the early days. "Two things about that are unusual. First, it is solid gold, and second, I won it by a fluke. It was the prize for the first London Derby in 1912. I was in second place as we raced toward the finish line when the poor bugger ahead of me ran out of gas and went in the drink.

"I was flying an airplane that had a few things I copied from an airplane I bought from the Wrights," he continued. "They had some fine design features but frightful controls. They were so illogical that I took some dual instruction before I flew the airplane. That was the only time in my life I ever had any dual. I threw out the controls after I bought the airplane and put in my own."

Lady Sopwith reminded Sir Thomas that it was time for their afternoon nap. The guests slowly gravitated toward the door, cameras in hand for some farewell pictures. Sir Thomas slipped on an old cardigan and grabbed a tall cane as he and his wife posed on the front steps with their aging Labrador, Brandy.

As we drove away I wondered how much longer that touching scene could last. The fine old dog went first. Lady Sopwith died five years later. Sir Thomas Sopwith followed her on the evening of January 27, 1989. He was 101.

*—Robert B. Parke*

**Update**

Piaggio has chosen AMR Services Corporation to market the P.180 Avanti in North America ("Piaggio," August/September 1988). AMR, a Dallas-based division of American Airlines, will sell and service the $4 million twin-engine turboprop through several U.S. regional offices. Richard Janise, president of AMR Services, says he believes AMR should sell between 500 and 1,000 Avantis in the next 10 years.

**Update**

NASA is seeking designs for a new orbital debris radar that will pinpoint objects the size of a dime orbiting at altitudes up to 360 miles ("Eyes on the Sky," April/May 1987). Currently, Air Force radar can track only objects four inches in diameter or larger. NASA's main concern is potential damage to the proposed space station, scheduled to be in service by 1996, caused by the massive amount of untrackable debris in low Earth orbit.

## *Pilot Pep Rally*

So you think you want to work for the airlines? According to Dan Mortensen, president of Airline Ground Schools in Rancho Cordova, California, the time has never been better to get that job. "Over the next 10 years," he says, "we expect a shortage of 40- to 50,000 pilots, 100,000 mechanics, and 100,000 cabin attendants."

The expected shortage is due to a predicted 65 percent increase in airline traffic by the year 2000, coupled with the retirement of some 18,000 pilots. United Airlines alone, says captain Gerald Blalock, is gearing up by hiring roughly 850 pilots this year even though it's losing only about 200 a year to retirement. And roughly two mechanics and two flight attendants are hired for each new pilot.

Even so, says Mortensen, you'll have to play it pretty cool to beat the competition. Last December Mortensen sponsored a one-day seminar in which a panel of experts counseled some 100 candidates on how to get the job, including how to handle stress and how to dress. (Similar workshops will be offered throughout West Coast cities this year.)

Pilots, of course, must first meet the minimum airline requirements: age 23, fluent in English, good moral character, high school diploma, first-class medical certificate, commercial pilot's license, and 1,500 hours of flight time, 250 flown as pilot in command. Though it's not required, a four-year college degree is virtually a must, and a master's degree is even better. But you can be overqualified—a Ph.D. will work against you.

United captain Bob Norris was at the seminar to share some secrets of the interview, a phase of the hiring process that he says many applicants are totally unprepared for. Be organized, neat, and punctual, he said, or at least give that impression. Learn what and where the company flies. Pronounce the interviewers' names correctly. Laugh at their jokes. Practice saying "yes sir" and "no ma'am." If the interviewer has a title, sprinkle it liberally throughout the conversation. "I worked hard to become Captain Norris," he explains, "and I like to hear it." Above all, act natural, but don't smoke, chew, spit, or pick.

Mortensen advised prospective Delta pilots to carry a family picture in their wallet. "It's a real family-oriented airline." If you don't have the picture, he warned, you won't get called back.

But according to captain Les Leech, a retired director of flight training for Eastern, nine out of 30 applicants wash out on the physical exam before even getting to the interview. High blood pressure, low sugar tolerance, high cholesterol, and evidence of drug use are the major culprits. And an increasing number of applicants flunk the hearing test, a result of what he calls "too much teenybopping."

If you do make it to the interview, be prepared to spend some money on clothes. Men should wear a three-piece suit, starched shirt, and new shoes, and learn how to knot a tie, the tip of which should hit the middle of the belt buckle. Get rid of the spare tire and mustache, and cut your hair military-style. He offered similar though modified advice for women.

There seems to be no limit on how much you can spend to boost your chances of getting hired. You can buy 12 airline applications for $25 from Airline Ground Schools and take the school's two-day class on the airline transport rating written exam for $235. You can sign up for a two-day

## *The Guiding Lights*

Pilots flying into New York's Kennedy Airport now have yet another series of lights to heed in the multi-colored sea of lamps that mark the airport's 23 miles of runways and taxiways.

In an attempt to prevent "runway incursions" ranging from fender benders between maintenance vehicles to ground collisions between aircraft, the Port Authority of New York and New Jersey and the FAA are testing a "stop bar" system at 15 runway-taxiway intersections. When a controller clears an aircraft to cross or enter a runway, another controller keys a panel to switch lights in the pavement and on poles flanking the intersection from red to green. The lights revert to red 20 seconds later. "The lights just back up the verbal clearance," says Mike Higgiston, a Kennedy Tower controller who is coordinating the one-year test.

MICHAEL DAVID BROWN

If the Port Authority, which is soliciting opinions from pilots and controllers, deems the test successful, stop lights may be installed at other Kennedy runways and at nearby La Guardia. Higgiston notes that while the system may significantly reduce "runway incursions," it may also increase congestion and delays. "It has to be weather-tested, too," he says. An enthusiastic snowplow could take out the stalk lights in one pass.

The system requires its own operator, whose sole function is to sit in the control tower for two hours at a spell listening to runway crossing clearances and pressing the appropriate button on a keyboard. During slow periods a stop bar system controller can get pretty antsy. "Now you know how a lifeguard feels," said T.J. Cross while he waited for an airplane to show up one sunny afternoon in January.

Kennedy was chosen as the prime test site for its runway accident potential—the airport is a vast and sometimes confusing network of taxiways and runways where a steady stream of international flights, whose crews occasionally struggle with English, are directed by a staff that speaks Brooklynese.

*—Patricia Trenner*

A torpedo's guidance and control subsystem directs the torpedo to the target to successfully complete search, homing, and attack missions. The Mk-48 Advanced Capability (ADCAP) torpedo, designed and built by Hughes Aircraft Company, initially receives its attack information from the submarine's fire control system. After launch, a long, thin communications wire between the torpedo and submarine serves as a real-time relay for changes in the torpedo's attack functions. Should the torpedo lose sonar contact with its target, its own tactical data processor returns to the search mode to relocate the target. If the target is able to initially evade the weapon, the ADCAP torpedo will re-enter and maintain an attack mode until interception.

A forward-looking infrared (FLIR) has been configured as a night sight for a variety of U.S. military weapons. The Hughes-built Thermal Weapon Sight (TWS) has been adapted for use with Stinger missiles, machine guns, grenade launchers, and all crew-served weapon systems. The TWS is a developmental passive infrared sensor employing a thermoelectrically cooled focal plane array that allows soldiers to locate targets and see at significant distances in battlefield conditions. It has a standard NATO weapons mount, and its telescope and reticle are easily changed to perform various duties.

A new superprojector provides large-screen display of computer data in full color. Designated Model 1000, the projector is designed for applications where real-time computer information must be viewed by large numbers of people. High-intensity xenon arc lamps, combined with the Hughes-developed liquid crystal light valve, generate a display with resolution in excess of 1,000 TV lines. Data is seen crisply and clearly, through front or rear projection, in normal room light. The superprojector is compatible with virtually all currently available computer sources and is derived from sophisticated color projection systems developed by Hughes for military command and control centers.

A new semiconductor device may significantly improve the performance of amplifiers at ultra-high frequencies. A new material system applied to the High Electron Mobility Transistor (HEMT), pioneered and developed by Hughes, uses a layered combination of gallium indium arsenide, aluminum indium arsenide, and indium phosphide to produce an amplifier that performs well at ultra-high frequencies with greatly reduced noise levels. Using HEMT devices, direct broadcast satellite receiving systems can be built using dish antennas less than three feet in diameter. Other potential uses are in digital circuits for high-speed radar signal processing and in high power millimeter-wave circuits.

Hughes' Combat Systems Engineering Facility in San Diego, California has immediate openings in advanced development and training to support the Navy Command and Control Processor (C2P) and Advanced Combat Direction System (ACDS) Programs. Experience desired for Combat Systems Engineers includes 7-9 years of system level development of military systems, preferably Surface Navy Combat Systems. For Computer Programmers/Instructors the level of experience desired is 4-5 years of designing, coding and debugging computer software. Teaching or training experience is desired. Applicants must have a B.S. Degree in Computer Science or the equivalent. Please send your resume to Hughes Aircraft Company, Ground Systems Group, Dept. S4, P.O. Box 4275, Fullerton, CA 92634. Equal opportunity employer. U.S. citizenship required.

For more information write to: P.O. Box 45068, Los Angeles, CA 90045-0068

HUGHES



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Stress Management session at the Pilot Performance Research and Training Institute in Santa Rosa, California, for up to $1,495. Or you can spend $575 for Bob Norris' Flight Simulation program.

Just when you begin to wonder if it's all worth it, Mortensen reminds the group what's at stake. The average annual salary for an airline captain is $105,000; for a first officer, $60,000. If hired as a captain at age 30, he says, you can earn nearly $4 million over the course of your career.

So make sure your application is the fattest one in the pile. Update it at every opportunity, and send a letter every time you accrue another 100 flying hours or another rating.

If you land the job, heed the advice of Delta captain Frank Mayne. "Never be separated from your luggage," he warns. "Don't make the flight attendant mad before you've had your meal. And never pick your nose in turbulence."

*—Elaine de Man*

### Update

Astronomers have discovered a new pulsar in the remnants of supernova 1987A ("Blast From the Past," August/September 1988). The superdense star, a teaspoon of which would weigh 300,000 tons on Earth, was first sighted on January 18 at Chile's Cerro Tololo Interamerican Observatory. The existence of the pulsar, which is spinning nearly 2,000 times per second, confirms theories about supernova creation and aftermath.

## *That's Terminal C as in Claus*

Santa Claus, a diminutive, squeaky-voiced, reasonably jolly fellow, arrived 17 minutes late. But after all, this *was* an airport—specifically, a lobby of the spacious new Terminal C at Boston's Logan Airport.

Santa, who rated a police escort, stationed himself in a chair underneath a 13-foot tower of poinsettias and next to a brass quintet playing carols. Mothers and children posed for complimentary Polaroids with Santa, which were then emblazoned on large souvenir buttons that were good for a free cone in Terminal C's ice cream shop.

"It was a nice thing to do," said Roberta Seidler of Needham, Massachusetts, who

WES EICHENWALD

was waiting with daughters Sarah and Elyse for a flight to Florida. All three wore souvenir buttons. "Santa was old and friendly and the ice cream was nice."

"I think it's terrific," said another mom standing in a check-in line with her son in her arms. "It gives you something to do while waiting for the plane."

Little girls sat on Santa's lap. So did teenage girls, older couples, and a few United baggage handlers. "We get a free ice cream outta this," said one baggage handler to a co-worker. "You didn't think we went there for nothin', didya?"

Santa's visit was part of the second annual two-week Massport Holiday Festival at Logan, which included musical performances, jugglers, and free sushi in the Cloud 9 Cocktail Lounge.

"The whole philosophy goes back to a desire to do something for the air travelers, to put some fun back into the experience," says Logan's aviation director Patrick Moscaritolo. "In the last couple of years it seems that the air traveler has been battered around, whether it's delays, congestion, lost luggage, complaints about prices rising—there's just been a great deal of disgruntlement. To travel [during the holidays] is always filled with a great deal of anxiety, so these are just little things we designed with the traveler in mind."

Logan's creature comforts predate the holiday season. Artwork hangs in the terminal corridors, along with suggestion boxes. And on-time arrivals and departures were up significantly in 1988, although the Massachusetts Port Authority's restrictive landing fee program, designed to ease traffic at Logan, has been put on hold.

Even if the emotions sparked by Santa's visit ran more to curiosity and amusement than true Christmas cheer, it was quite an improvement over business as usual—especially for those who asked Santa that all their flights arrive on time this year.

*—Wes Eichenwald*

## Update

Sweden's Gripen fighter prototype crashed on February 2 during its sixth test flight ("Sweden's 'Flying Weapon,' " February/March 1988). The only flying JAS 39 dragged a wing during touchdown at Saab's Linköping airstrip, then veered wildly and skidded off the runway when its landing gear collapsed. Pilot Lars Radestrom escaped with minor injuries.

Though the maiden flight last December was 18 months late , Saab had said the first of the 350 to 400 JAS 39s ordered by the Swedish air force would be delivered in 1992, as originally scheduled. Saab officials say that until the accident is investigated, they will not be able to tell how the crash will affect the delivery schedule. Sweden limits arms exports to stable governments, so in order to recoup some of the Gripen's developmental costs, industry officials hope to sell up to 200 JAS 39s to Finland, Denmark, Austria, Switzerland, and Norway.

### *Struck by Lightning*

On the last weekend of January, the Santa Maria airport in Southern California was transformed into a wartime Pacific aerodrome. A half-dozen P-51s with names like *Jolley Roger* and *Sizzlin' Liz* flew low and fast over the runway, Merlin engines howling, and a pristine P-38 named *White Lightnin'* was poised on the ramp.

The occasion was the 50th anniversary of the Lockheed P-38 Lightning's first flight, and some of its pilots had come to celebrate. Among them were John Mitchell and Rex Barber, pilots in the 339th Fighter Squadron flight of Lightnings that shot down Admiral Isoroku Yamamoto, one of Japan's premier tacticians and architect of the Pearl Harbor attack.

Mitchell set up a map at the podium and returned to that bright April day in 1943, and as he and Barber took turns recounting their mission, they were once again young warriors out to face the best of Dai Nippon.

"The Japanese were changing their code every 30 or 45 days," Mitchell said, but the

elite cryptography group at Pearl Harbor was keeping up. "On April 13 our naval intelligence picked up two coded transmissions." Yamamoto was planning to fly 400 miles southeast from Rabaul, New Guinea, in a Mitsubishi G4M "Betty" bomber escorted by A6M "Zero" fighters. He would arrive at Ballalae Island in the Solomons at 9:45 a.m., April 18, to inspect his troops. On April 17, a cablegram arrived at Henderson Field on Guadalcanal in the Solomons carrying the order: "Destroy the target at any cost."

"[Admiral Marc] Mitscher wanted to know if we could get Yamamoto by attacking his boat," Mitchell told the audience. "Yamamoto was going to travel between islands in a submarine tender. I told the admiral that I could hardly tell a submarine tender from a submarine, and in any case, even if we sank the right ship, Yamamoto might get away in a dinghy or Mae West. I said the surest way to get him would be to shoot him down in the air."

To do so the 16 P-38s, carrying long-range fuel tanks, would have to take off from Guadalcanal at 7:30 a.m., then fly northwest for two hours at an altitude of 50 feet, out of sight of islands that held Japanese coast-watchers. Navigation equipment was spartan: dead-reckoning by compass, wristwatch, and airspeed indicator would have to guide the Lightnings over 436 miles of open sea.

Ordinarily Yamamoto and his staff wore dress whites, Mitchell said, but it was later discovered that the admiral had decided on fatigues for this field inspection. When two aides showed up at the Rabaul airstrip in dress uniform, Yamamoto considered sending them back to change. But he decided his schedule was more important—a decision that cost him his life.

"We came up to the coast of Bougainville within a minute of our planned arrival time," Mitchell said. A pilot broke radio silence to say he had spotted two Betty bombers with an escort of six Zeros. While 12 Lightnings climbed to fly cover at 20,000 feet, Tom Lanphier, who Mitscher chose to lead the attack flight of four P-38s, made his move, with Barber glued to his wing.

Lanphier went after the lead bomber but was immediately jumped by three Zeros. He turned his attention to his attackers, leaving Barber to shoot at the bomber. When Barber flew past the smoking Betty and then glanced behind him, he saw the bomber gliding just above the trees. After escaping three Zeros, a second look back revealed a pillar of black smoke rising from the Bougainville jungle.

Meanwhile, Lanphier had shaken off the Zeros and had begun firing at what he thought was the lead Betty, trying to stay out of range of the bomber's tail cannon. After losing a wing, it too went down. With the loss of a single P-38, the 339th Squadron had wreaked havoc with Japan's morale. The death of the brilliant commander-in-chief of the Imperial Navy was a devastating blow.

Lanphier and Barber were both credited with downing Yamamoto's airplane, but most accounts later attributed his demise solely to Lanphier. In November 1985, however, at the Admiral Nimitz museum in Fredericksburg, Texas, a unique videotape was shown to the pilots of the 339th Squadron during their reunion. In it, Zero pilot Yanagia Kenji recalls the single P-38 that latched onto Yamamoto's bomber and laced it with bullets until it crashed. And in a 1984 letter from a Japanese historian, the leader of the Yamamoto rescue party is quoted as saying that the Admiral's bomber, astonishingly, carried no guns. Examination of the wreckage revealed that Yamamoto had died not from the crash of an airplane that had lost a wing in flight, but from Barber's bullets.

Soon after Barber finished his story, *White Lightnin'* was rolled into the hangar, and a banquet and dance were soon under way. A college band played big-band music, and a World War II flier listened appreciatively to "String of Pearls"—"Those kids are doin' all right." All too soon 1989 would return, but now it was time to remember when life was an adventure and all things seemed possible.

*—T.A. Heppenheimer*

**Update**

Marriott will soon be feeding Aeroflot passengers some 10,000 meals a day ("The Deregulation Diet," April/May 1988). Aeromar Ltd., a new Soviet company, put Marriott in charge of Aeroflot's Moscow kitchen in an attempt to improve Aeroflot's competitiveness. Currently, a typical Aeroflot meal, supplied by a government agency, consists of chicken, black bread, cheese, and tea, but the supply and quality vary. Marriott hopes to rectify that by buying food from European and semi-private Soviet suppliers. The meals will cater to Russian, European, and American tastes.

**Update**

Balloonist Julian Nott now has the crew, schedule, and nearly 60 sponsors for the first nonstop round-the-world flight in a helium balloon (Soundings, October/November 1986). Nott selected cinematographer Eugene Squires as his right-hand man for the $1.5 million effort, which will begin near Los Angeles in late March. By flying in the jet stream, Nott hopes to cover some 25,000 miles in 10 to 20 days.

## *For Want of a Letter . . .*

Now orbiting Mars after a July 12, 1988 launch, the probe Phobos 2 is expected to rendezvous with the Martian moon Phobos early this April.

But what is the fate of its sister ship, Phobos 1, also launched last July? It failed to respond to radio messages from Earth last September, and further attempts to make contact proved unsuccessful.

"There is no doubt that this was a heavy blow on us," says Roald Sagdeev, head of the Phobos project. "After the succession of commands sent to the spacecraft was analyzed, it turned out that in one of the instructions sent just one letter was omitted. As a result an erroneous command was issued to switch off the system which ensured the probe's orientation.

"So, an operator's mistake led to an irreparable loss. Phobos 1 started a chaotic rotation." The spacecraft's solar cells could no longer collect solar energy, and its communication antenna could not maintain Earth orientation.

Eventually Phobos lost all power, and despite a month-long effort to resume contact the spacecraft remained unresponsive. "Uncontrolled, Phobos 1 will become an artificial satellite of the sun," says Sagdeev. "All the hopes of Phobos researchers are now pinned on the second spacecraft."

*—Gennadi Maximov*
*Novosti Press Agency*

**Update**

Night vision goggles, worn by Army helicopter pilots, are undergoing a safety investigation by a House armed services subcommittee (Above & Beyond, June/July 1986). Since October 1988 representative Frank McCloskey of Indiana had been calling for suspension of training missions that required the goggles, after several crashes were linked to the equipment. Following the February 1 crash of two helicopters at Ford Ord, California, McCloskey again urged that NVG missions be temporarily suspended, but Army officials refused. The safety of both the older Series 5 NVGs and the new lightweight Series 6 is being questioned.

# Anniversaries . . .

**1930**
**May 5** British aviator Amy Johnson begins a solo flight from Croydon, England, to Port Darwin, Australia. On a typical day, Johnson flew for 10 hours, then spent five hours maintaining her engine. The next morning she would rise before dawn to resume her journey. *Jason,* her de Havilland Gipsy Moth biplane, carried no radio and was damaged several times upon landing. Fatigue, sandstorms, tropical heat, and a lack of supplies threatened her success, but after 20 days of travel, Johnson landed in Port Darwin, becoming the first woman to complete the 10,000-mile solo flight. The trip earned her fame, wealth, and a marriage proposal, which she accepted.

NASM

*Australians went wild over Amy Johnson, the first woman to fly solo from England.*

**1934**
**April 8** Ovid Victor Ottley, age 14, flies solo from the Abridge Aerodrome in Essex, England, after receiving only five hours of instruction. His five-minute flight and flawless landing were witnessed by a crowd of curious onlookers; his mother, however, chose to remain inside the aerodrome's clubhouse until assured of her son's safety.

NASM

*The XC-35's pressurized cabin shrieked with leaks during the first ground test.*

**1937**
**May 7** The first successful pressurized-cabin airplane, a Lockheed XC-35 built for the Army Air Corps, makes its first flight. A forerunner of modern transports, the all-metal XC-35 led to faster, safer, and more comfortable air travel: its crew of six could ascend to over 25,000 feet without suiting up against the cold or using oxygen. During the first ground test, the aircraft emitted whistling sounds that ascended in pitch as pressure was increased, prompting scores of workers to rush from the hangar (the cabin turned out to have leaks). On one flight, an enthusiastic engineer started operating pressure control levers "like a switchman in a busy freight yard," wrote Captain Alfred H. Johnson, an XC-35 test pilot. With cabin pressure changing the equivalent of 4,000 feet several times a minute, the crew members felt as though their heads were expanding like blacksmith's bellows, and they soon strapped the engineer into a seat far removed from the controls.

**1938**
**April 16** Henry Ford, who had bought the Wright brothers' old home and bicycle shop, dedicates them as part of the Ford museum in Dearborn, Michigan.

**1939**
**April 1** The Mitsubishi A6M1, a prototype of Japan's "Zero" fighter, makes its first flight from Kagamigahara, Japan. The Zero, an all-metal monoplane, took the United States by surprise in the bombing of Pearl Harbor and threatened Allied air power for the next two years. Flight requirements set by the Japanese navy were "so severe as to seem almost impossible," wrote Jiro Horikoshi, the airplane's designer. "However, if we could achieve them, we would have the world's best fighter." Famed for its long range and maneuverability, the Zero had a lightweight airframe, retractable landing gear, and a detachable auxiliary fuel tank.

**1945**
**May 5** A woman and five children are killed in Lake County, Oregon, the only casualties of enemy action on the U.S. mainland during World War II. While on an outing, Elsie Mitchell and the children came across a Japanese balloon bomb, which detonated as they examined it. Only a month earlier, Japan had stopped lofting balloon-borne explosives because a news blackout on the balloons by the U.S. press had caused the Japanese to doubt the success of their attacks.

*Japan menaced the United States with balloon-borne bombs during World War II.*

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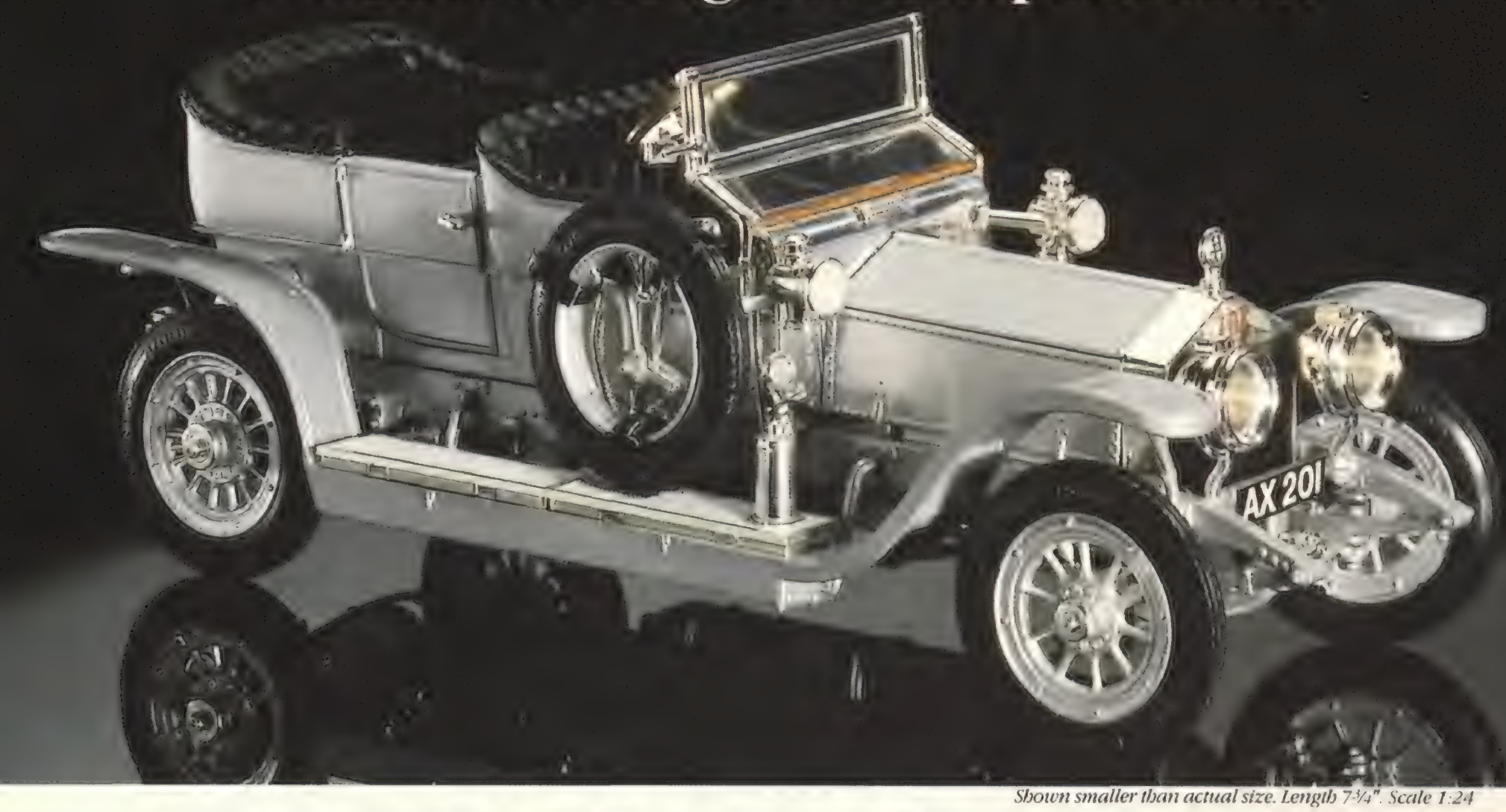


*Shown smaller than actual size. Length 7¾". Scale 1:24*

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*The authorized die-cast model of the most famous Rolls-Royce ever. Plated with sterling silver to match the original.*

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A scale re-creation with such convincing standards of detail, quality and precision that Rolls-Royce Motor Cars Ltd. has recognized it as the *authorized* die-cast model of The Silver Ghost.

And so scrupulously accurate that company officials have verified the model for authenticity.

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There are soft tufted seats, doors that open and close, fully operable steering, complete instrumentation—and engine detailing that shows the *two* sparkplugs on each of six cylinders.

What price perfection? A custom model of this quality would cost hundreds or even thousands of dollars. But The Silver Ghost is just $120, and payable in five installments of $24 each.

Crafted and imported exclusively by Franklin Mint Precision Models, it's available by direct application only. So be sure to order by May 31, 1989.



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Please enter my order for a precision-crafted 1:24 die-cast replica of "The Silver Ghost," with sterling silver plated trim, protectively coated. It is to be sent to me fully assembled and ready for display, together with its Certificate of Authenticity.

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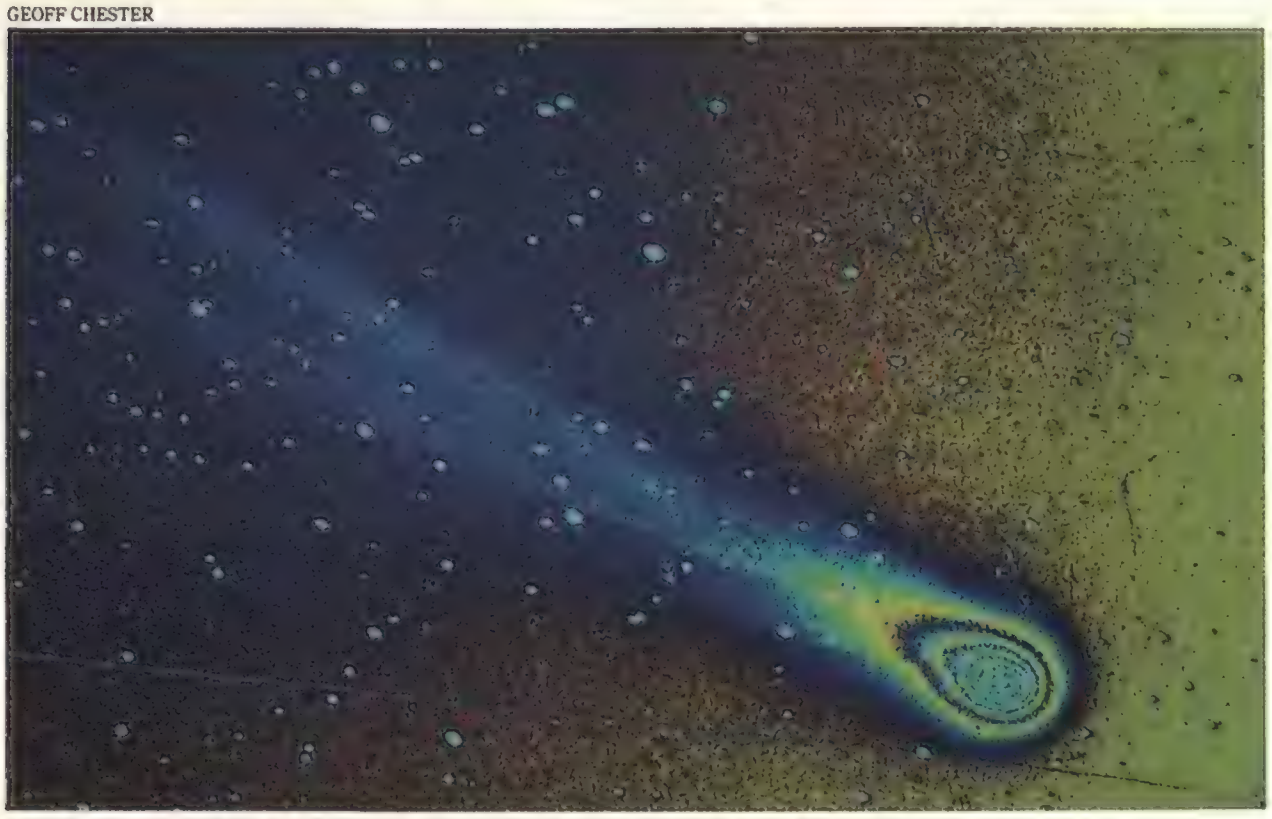
*In* 2001, *two astronauts struggled against HAL, an omniscient spacecraft computer.*

**1968**
**April** Stanley Kubrick's award-winning science fiction film *2001: A Space Odyssey* premieres. With its spare dialogue and special visual effects, the film was a stunning depiction of life in space. Described as "the ultimate trip," the film kept audiences guessing about its meaning. "I don't want to spell out a verbal road map for *2001* that every viewer will feel obligated to pursue or else fear he's missed the point," said Kubrick in an interview. Rather, he hoped that the film would reach people "who would not often give a thought to man's destiny, his role in the cosmos, and his relationship to higher forms of life."

GEOFF CHESTER



*Scientists loved it, but amateur observers considered Halley's comet a flop.*

**1983**
**May 9** Seven women aboard a C-141 transport become the Air Force's first all-female crew to fly a round-trip mission across the Atlantic. The women took off from McGuire Air Force Base in New Jersey and stopped once in the Azores before flying to West Germany to pick up gravelv ill Americans for return to the United States. Air Force officials hoped that the flight would increase awareness of the role of women in airborne operations. Said Captain Giuliana Sangiorgio, one of the C-141's two pilots, "The novelty of women flying will wear off in time, and we'll be better off when it does."

**1985**
**April 29** Along with seven astronauts, two monkeys, and 24 rats, Welch's new Squeezable Jellies fly into orbit aboard the space shuttle *Challenger.* Advertisements for the jelly, which is housed in plastic squeeze bottles, boasted that "Welch stops the Blops in outer space!"

**1986**
**April 11** Halley's comet passes within 39 million miles of Earth on its first visit since 1910. Like Comet Kohoutek in 1973, Halley was a hit with merchandisers but left observers disappointed with its dim, fuzzy appearance. Two months earlier, the U.S. Naval Observatory even unplugged its Halley's Hotline due to a dearth of calls. "This is a poor excuse for what it was in 1910. It was scary then—weird. It was like a blowtorch in the sky," one man told the *New York Times.* The comet will next visit Earth in 2061.

**1988**
**April 15** A Soviet Tupolev Tu-155 airliner, one of its engines fueled by liquid hydrogen, makes its first flight. Although the engine performed well, Soviet designer Youry N. Popov said that difficulties in using liquid hydrogen make it an impractical airliner fuel for the near future.

# . . . and Events

**April 4–7**
National Space Symposium. Hosted by the United States Space Foundation. At the Broadmoor Hotel, Colorado Springs, CO, (719) 550-1000.

**April 8**
Airlines International Annual Trade Show. Buy, sell, or trade airline memorabilia. At Holiday Inn, Dallas-Fort Worth South, Irving, TX, (817) 540-9604.

**April 14–16**
Ozark UFO Conference. Lectures on all aspects of UFOs. At Inn of the Ozarks, Eureka Springs, AR, (501) 354-2558.

**April 15**
Shirts & Skirts Air Race. A 300-nautical-mile speed race hosted by the Ninety-Nines. At Fullerton Municipal Airport, Fullerton, CA, (714) 532-3207.

**April 22 & 23**
Texas Air Expo. Skydivers, vintage aircraft, and helicopter rides. At Texas State Technical Institute Airport, Waco, TX, 1-800-WACO-FUN.

**April 29 & 30**
Kalamazoo County Annual Kitefest. Kite-making workshop and "Godzilla's Revenge," in which fliers use kites to knock an apple off the head of an inflatable monster. At River Oaks Park, Kalamazoo, MI, (616) 383-8778.

**May 4 & 5**
Naval Aviation in Space Symposium. At Pensacola Civic Center, Pensacola, FL, (904) 453-NAVY.

**May 11 & 12**
American Bar Association Air and Space Law Forum. At Stouffer Madison Hotel, Seattle, WA, (312) 988-5579.

**May 20 & 21**
Open Cockpit Weekend. Sixteen aircraft and flight simulators open for inspection. At New England Air Museum, Bradley International Airport, Windsor Locks, CT, (203) 623-3305.

*Organizations wishing to have events published in Calendar should submit them four months in advance to Calendar,* Air & Space/Smithsonian, *AIAA Bldg., 370 L'Enfant Promenade SW, 10th Floor, Washington, DC 20024. Events will be listed as space allows.*

*—Diane Tedeschi*

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# A Phantom's Story

ROBERT C. MIKESH (2)


*The McDonnell Douglas F-4 Phantom was "everything a fighter pilot could want."*

"There were two of us and four of them." Navy captain Samuel C. Flynn (Ret.) begins his story, telling it with a fighter pilot's studied cool. The two McDonnell Douglas F-4 Phantoms were flying a combat air patrol mission on a June morning in 1972 when they encountered four MiG-21s northeast of Hanoi.

"We were out about 8,000, 9,000 feet at about 500 knots and they started rolling in on us," Flynn says. One MiG stayed high; the other three circled nearer. "On the first turn, we were turning probably about six, six and a half Gs, and one of the MiGs got what I call 'spit out of the fight': he couldn't turn with us, so he kind of vectored off to the east and we never saw him again."

Flying primarily in the vertical to compensate for the MiG's greater maneuverability, Flynn and his radar intercept officer, then-lieutenant William H. John, went after the MiG circling outside and high; their wing man pursued the inside-and-low one. Flynn had an AIM-7 Sparrow missile locked on the MiG, but the missile didn't work. The MiG rolled around and Flynn fired another missile, but it went wide of the mark.

"And then he saw me and started coming back after me," Flynn continues, "and as I was turning, I finally got a tail-on shot with a Sidewinder." The missile struck the MiG's tail, sending it into an unrecoverable spin. The remaining MiGs departed, leaving the two F-4s free to refuel and return to their carrier, the USS *Saratoga.*

That same year, Smithsonian curators were on a mission of their own. Called Project Update, its goal was the acquisition of military airplanes dating beyond 1955, an era not represented in the Institution's aircraft collection. Among the curators' targets: an operational Navy F-4.

The F-4 Phantom, the dominant U.S. fighter in Vietnam, was responsible for more than 200 MiG kills—more than any other aircraft. Beginning in 1958, over 5,000 of the twin-jet, two-seat fighters were manufactured and continually refined over the next two decades for use by the Navy, Air Force, Marines, and friendly foreign governments.

At the Smithsonian's request, the Navy submitted a list of F-4s with military combat kills. The Institution selected two, but over the years they somehow slipped away, winding up at the storage facility at Davis-Monthan Air Force Base in Arizona to be used for parts.

"When I sensed things were not going well," recalls Robert Mikesh, now the National Air and Space Museum's senior curator for aeronautics, "there were two airplanes still on the Navy records that had victory kills. One was already at Davis-Monthan. The other one was still operational, in Hawaii."

Thinking it best to go with a sure thing, he selected the one at Davis-Monthan. But the airplane was no longer flyable, and shipping it back to Washington would be difficult and expensive. So Mikesh turned to the Hawaiian F-4, then assigned to a Marine Corps squadron. It was the Phantom Sam Flynn had flown in Vietnam the day he shot down the MiG.

Last October, Mikesh got a phone call from Hawaii. The Marine squadron had heard that one of its Phantoms was to enter the Museum's collection and offered to spruce it up. Mikesh gladly accepted, and the following month received word that the fighter was on its way to Dulles International Airport outside Washington.

"Well, I was sitting there, and I failed to see the landing because they were approaching from behind the terminal, but all of a sudden, appearing in front of me on the taxiway, was this Phantom. I looked out and I thought, 'This doesn't look right. But it *is* right. But yet it isn't right . . . .' "

A few seconds later Mikesh realized the source of his confusion. The F-4 didn't look like the Phantoms used today. The Marines had painstakingly restored the jet as it would have appeared as a Marine Corps fighter in Vietnam.

Because of the Museum's insistence on historical accuracy, however, the aircraft will eventually have its Navy markings restored. The fighter will remain in a protective shelter at Dulles until the construction of an extension to the Museum will permit its display.

Of his former fighter, Sam Flynn's praise is quick and explicit: "It was tough!" Then he laughs, adding, "It was not very vulnerable to gunfire." But his fighter pilot cool slips away when he talks about the Phantom's newest assignment. "It means an awful lot," he says.

*—Karen Jensen*

### *The Phantom: A Pilot's View*

In the seven years after I received my wings in 1961, I served in four Marine Corps tactical squadrons as both a fighter and a photo reconnaissance pilot in the Vought F-8 Crusader. To many of us, the F-8 was the embodiment of everything a fighter was supposed to be. During two overseas tours, I had grown to love it for its performance and ruggedness.

But time marches on, and the Marine Corps retired the Crusader in 1968. When I returned to the States from Vietnam that November, I was assigned to Marine Aircraft Group 32, then located in Beaufort, South Carolina, in order to acquaint myself with my new airplane: the McDonnell Douglas F-4 Phantom II.

Oh, I considered myself well familiar with the Phantom and its mission; there had been a rivalry between Phantom and Crusader jocks for some time. Impromptu mock air-to-air combat between F-4s and Crusaders had found the Phantom wanting in all the qualities that measure a fighter—though in retrospect I think many Phantom crews had not learned to exploit its maximum capability. To me, the F-4 was just too big, too ugly, and had too many people in it to be called a fighter. Besides, who ever heard of a fighter with no guns? I was less than enthusiastic about my upcoming assignment.

I was lucky, however, in that my introduction to the F-4 paralleled a flood of improvements in the airplane: modifications to flight controls and the weapons system, increased capability and reliability of the radar, better missiles, and enhancements to maneuverability gradually removed early deficiencies and helped win me over.

The Phantom was big for a fighter. In air combat tactics, flying it was akin to driving a dump truck in an obstacle course. The F-4's acceleration, however, proved one basic aerodynamic principle: with enough power, even a brick will fly. As a matter of fact, it could outrun some of our newer fighters at low altitude. I couldn't believe it the first time I left behind an F-15. While not as nimble as a Soviet MiG, the F-4's two powerful J79 engines, each developing 17,000 pounds of thrust in afterburner, gave the bird a vertical maneuvering advantage over any non-U.S. fighter.

I flew my last Phantom sortie in 1985. I had logged 2,000 hours flying that thing, and with each passing hour had grown to love the airplane. I flew it in combat in 1972, and it lived up to its reputation as a superb bombing platform as well as a fighter. By then, not only had the airplane improved but the crews who flew it had benefited from programs of intensive training; the Navy's famous Top Gun program had been designed originally to improve Phantom crew performance. As I walked away from my last F-4 flight, the airplane no longer looked too big or too ugly. It was almost everything a fighter pilot could want.

*—Colonel Denis J. Kiely*
*U.S. Marine Corps*

*Now painted as a Marine fighter, the F-4 will eventually regain its Navy colors.*


### *Museum Calendar*

Except where noted, no tickets or reservations are required. Call Smithsonian Information at (202) 357-2700 for details.

**April 1** Monthly Sky Lecture: "The Martian Explorations of Lowell and Campbell." David DeVorkin, NASM department of space history. Einstein Planetarium, 9:30 a.m.

**April 5** Search for Extraterrestrial Intelligence Lecture: "Signals of Intelligence." How radio telescopes scan the cosmos for signs of life. Jill Tarter, NASA-Ames Research Center. Einstein Planetarium, 7:30 p.m.

**April 6** General Electric Aviation Lecture: "The X-29." Kurt Schroeder, pilot of the airplane. Langley Theater, 7:30 p.m.

**April 12** Exploring Space Lecture Series: "Early Star Evolution and Planet Formation." Frederick M. Walter, Center for Astrophysics and Space Astronomy, University of Colorado at Boulder. Einstein Planetarium, 7:30 p.m.

**April 25** Smithsonian Resident Associate Program Lecture: "Phobos Mission to Mars." Geoffrey Briggs, NASA. Cost: $7 members; $10 non-members. Baird Auditorium, National Museum of Natural History, 8 p.m. For more information, call (202) 357-3030.

**April 29 & 30** "Wings and Things" Open House at NASM's Paul E. Garber Preservation, Restoration and Storage Facility, Suitland, Maryland. Participate in aerospace-related activities for the whole family. 10 a.m. to 3 p.m. For more information, call (202) 357-2700.

**May 6** Monthly Sky Lecture: "Solar Eclipses." Fred Espenak, NASA-Goddard Space Flight Center. Einstein Planetarium, 9:30 a.m.

**May 10** Exploring Space Lecture Series: "The Hot Stars of Planetary Nebulae." Sally Heap, NASA-Goddard Space Flight Center. Einstein Planetarium, 7:30 p.m.

**May 12** New NASM gallery opens: "Beyond the Limits: Flight Enters the Computer Age." Exhibit of computer applications in aerospace.

**May 18** Charles A. Lindbergh Memorial Lecture. George McGovern, former senator and Air Force pilot. Langley Theater, 8 p.m.

# Lost in a Fighter

Immediately after the end of World War II, U.S. intelligence services weren't sure if the Japanese in Manchuria were going to surrender or keep fighting. As a precaution the Navy moved into Shanghai, and my P-51 fighter squadron, the Yellow Scorpions (530th Army Air Forces-China Theater, ex-14th Air Force), was assigned there to provide fighter cover. It proved to be a leisurely life. To maintain our proficiency we flew an hour or two a day, mostly acrobatics or a dogfight or two with another flight.

In November 1945 a political decision disrupted our routine. Brand new warplanes, no longer needed now that the military was being demobilized, were being destroyed. The powers-that-be decided to give the airplanes to the Chinese nationalists instead, to help in their struggle against the communists. Politics being what it was, the Chinese pilots could not go to India to take delivery of the airplanes, so the U.S. units still available were assigned to ferry the airplanes—a total of some 700 fighters and transports—to China. Most of us looked forward to the diversion, though some pilots grumbled about being put at risk now that the war was over. But the military discipline we had learned required that we follow our orders without question—even if we knew they were wrong.

The flight, from Calcutta to Kunming, then on to Shanghai, would not be easy. We would have to navigate by dead reckoning, using maps that were often inaccurate and flying by instruments that were primitive by today's standards. But our main concern was fuel. Our capacity for the 1,200-mile nonstop flight between Kunming and Shanghai didn't allow much for adverse winds. All the airplanes had external drop tanks, though, giving us a safety margin sufficient for normal conditions.

We were flown to Calcutta, where we took possession of our Mustangs. A few days later our 24 airplanes took off on the first leg, over the Hump to Kunming, in flights of four. Problems cropped up immediately. Near the India-Burma border one airplane's coolant system exploded. The pilot managed to bail out, although we later learned he was badly burned. The rest of us landed safely in Kunming just before noon.

The weather service, like the rest of the military, had undergone postwar dismantling, and weather information for the long leg to Shanghai was sketchy. One report—how old it was we didn't know—from either Changsha or Nanchang said there were broken clouds. There was no report at all from Shanghai. A B-25 crew that arrived from the east reported cloudy skies and storm clouds near Changsha, but said that we could top everything at 18,000 feet.

We took off into clear weather and joined up into a loose squadron of 23. Except for the hum of our engines the flight was serene and quiet. But before long we were flying over a solid and darkening undercast that forced us to climb to stay above it. By the time we reached 20,000 feet some airplanes began to have trouble keeping up and the squadron deteriorated into individual flights. I kept up with the squadron commander and two other airplanes. Together we continued to climb in an attempt to top the storm. Even at 30,000 feet we had storm clouds above us.

Up ahead loomed a wall of clouds we couldn't hope to top, but since they were rather light I thought we could fly right through them without losing sight of one another in formation. The squadron commander obviously felt differently and started a gentle turn and descent into a large valley of clouds. We began to descend in circles, losing the cloud horizon, and soon I became convinced that we were in a steep turn. My instruments, however, told the truth—we were flying level. A few seconds later I was sure that I was level, but the instruments showed I was in a steep turn.

The cloud valley was funnel-shaped, and as we descended into it our turns became tighter. Soon we were having trouble holding formation and one of the airplanes disappeared into the clouds. The radio frequency was crowded with voices as pilots called one another for instructions.

Then a voice in my head got through to me. "You're completely disoriented," it said. "You'd better get out of here and go on your own." A stronger voice, the voice of military discipline, answered: "If you do and lose the airplane you'll be court-martialed." I attempted to hang on despite my vertigo.

At 22,000 feet I had fallen slightly behind and above my element leader, who was still trying to stay with the squadron commander. Then we were into the soup, visibility completely cut off by the thick clouds. My training took over. "You were in a slight dive," I said to myself. "A little back pressure on the stick will hold your altitude. Sweep your instruments and take control of your plane's attitude. You're on your own."

I focused on the instrument panel but all I could see was the gyroscopic instruments spinning and tumbling. Then the trash and dust in the bottom of the cockpit came floating past me into the canopy and I realized that I was upside down. I didn't consider for a moment trying to recover; I was going to bail out.

Then, without thinking, I did the smartest thing anyone could have done. As I tried to release my seat belt and unhook my oxygen hose from the one attached to the airplane, I let go of the controls. Using both hands I tried to pull the hoses apart, but they were the flexible, expandable type, and I could have been playing the accordion for all the good I was doing. Apprehension turned to panic. It was like a nightmare where dreadful things happen and you are totally incapable of reacting. My mind didn't go blank; I was perfectly aware of my situation but I just couldn't function. I knew that I needed to pull the hoses apart at their disconnect rings—but I didn't do it. I stopped wrestling with the hoses and released the canopy instead.

My senses had not left me completely—I remembered to duck to keep the canopy from slamming me in the forehead. It left in fine shape, and as I lifted my head I noticed that the artificial horizon was level. My eyes stopped there. It remained steady! I took the controls and cross-checked needle, ball, and airspeed. My panic disappeared.

The airplane was practically level at 12,000 feet. After I had released the controls to bail out, the P-51 had done a 10,000-foot split-S and recovered, just as its engineers had intended it to.

But I was still in a storm, with no canopy and no idea where I was. I was going to bail out. However, I had to be a good two hours or more from Shanghai, so I decided to fly a little closer before jumping. I dropped my seat to the floor and hunched up behind the protruding windshield and gunsight. It got me out of the frigid rain and snow whistling through my open cockpit.

The noise of the wind made communications impossible. I did have a 30-degree Bendix direction finder and could make out non-Chinese music around the frequency of the Shanghai armed service radio. The direction finder zeroed in on the music and centered near my heading.

After a while I left the rain and snow behind, and the clouds got lighter. I flew into a small vertical space between two cloud decks and stayed there, where I had enough of a horizon to allow me to get off instruments intermittently. The stratified layer also put me into a gentle descent, but my maps showed me that the highest peak in the area was only 7,000 feet. I was still at about 10,000 feet. I'd be fine.

Every so often I'd look over the side of the cockpit to search for a hole through the clouds. I had descended below 9,300 feet when I ventured another look. It wasn't the sight of a pine tree below that shocked me—it was the fact that I could distinguish individual needles. I hauled back on the stick and wondered when the crash was going to come. A few seconds at a time like this seems like an eternity. When I relaxed my grip I was back at 12,000 feet.

I spent the next 10 minutes trying to figure out where the hell I was. There was no mountain range with those elevations anywhere near our course. Then it hit me: the map's inaccuracies included elevations! I must have passed over the last mountain range before Shanghai.

I decided to fly level for another 10 minutes before letting down. I broke out at 8,000 feet over a large lake in the flatlands. I soon spotted an abandoned Japanese airstrip and considered landing there instead of bailing out. I circled it, wondering how muddy it was and if I could land gear-down without flipping the P-51 on its back. I was starting my second or third circle around the strip when I noticed modern buildings on the horizon. I must have been halfway around the strip again before it dawned on me that there were only two cities in all of China that had a skyline like that. One was Shanghai; the other was Hong Kong, over 1,500 miles to the south. This certainly was not Hong Kong.

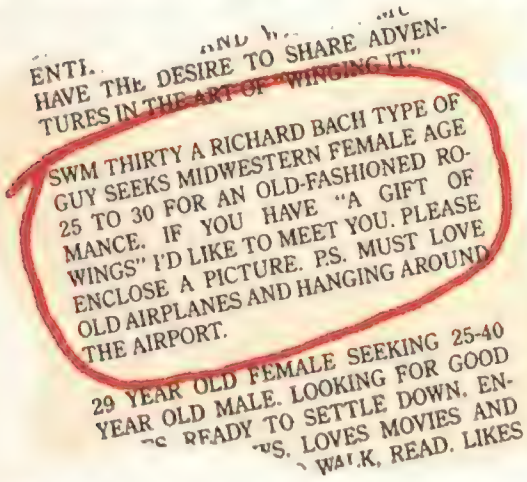
Ten minutes later I was on the ground at our home base, the fourth plane in. Of the 24 airplanes that had set out from India, only 14 made it. Four pilots died, including my roommate, and our squadron commander was never found. Six pilots bailed out successfully. Because of the losses, Lieutenant General Albert C. Wedemeyer, commander of the U.S. forces in China, ordered the flights halted.

Sometime later I flew out over the mountain in clear weather. As I skimmed four or five feet over the top at 9,250 feet, I couldn't recognize the tree that had nearly killed me—but then I wasn't quite as low this time.

*—Toby Elster*

PAUL SALMON

# *Plane People* Who Need People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Visualize it, gals. You and he meet at the romantic little airport nearby, join hands, throw back your heads, and laugh madly as you hurry past the fuddy-duddies in the pilots' lounge. At your airplane you engage in impetuous preflight hijinks involving a hose, a bucket of suds, and a playful pooch named Flyin' Laddie. Then . . . aloft. And as you burst through the ragged clouds into the bright, boundless azure, he breaks into a passionate recital from *Jonathan Livingston Seagull.*

All right, so maybe you, personally, would rather walk into a spinning propeller. But somewhere out there is a woman, currently flying solo, who will read this ad and sigh, "Ohhh, dream date." She and the Bach-man need to be brought together. And that's the idea behind the newsletter that ran the above ad: *Plane People,* the new, nationally distributed organ of a service called Aviation Singles.

*Plane People* is the brainchild of Ron Angle, a 26-year-old mechanical and design engineer and glider pilot who wants to set up a network for "meeting people who are addicted to flying, or just enjoy airplanes." And I'll be honest, when I first encountered *Plane People* and its somewhat wimpy ads (*SWM, 30, 5-11, sincere, athletic, romantic, conservative with nutty days . . .* ), I was gleeful. You see, I'm one of those non-Plane People who, feeling thoroughly inadequate in a culture saturated with stud-pilot stereotypes, takes delight in any demonstration that many male pilots are, in fact, geeks. Many Ground People feel this way. It's a reaction to all those paternalistic airline captains and pilot magazine articles titled, "Seaplane Snafu: With Avgas Filling the Cockpit, Suddenly This Bird Was No Longer Soaring!"

The subculture of goober pilots is a well-known phenomenon to insiders, but to us laymen the emergence of a pilot like Mathias Rust was a revelation. Rust's 1987 Helsinki-to-Moscow flight in a Cessna 172 made him an international folk hero. But when the dust settled his undeniable nebbishness emerged. At his trial, instead of clenching the old lantern jaw and snarling, "Nuts to you, Ivan," Rust whined that his flight was really . . . a peace mission. "My goal was to make contact with the leader of this country . . . and to explain to him my ideas," he said, expressing the same kind of pathetic delusion one associates with MENSA members and Dungeons & Dragons buffs. By the time he sold his story to *Stern,* a magazine that 12-year-old Mathias Rusts read under the covers, he was Germany's Official Nerd.

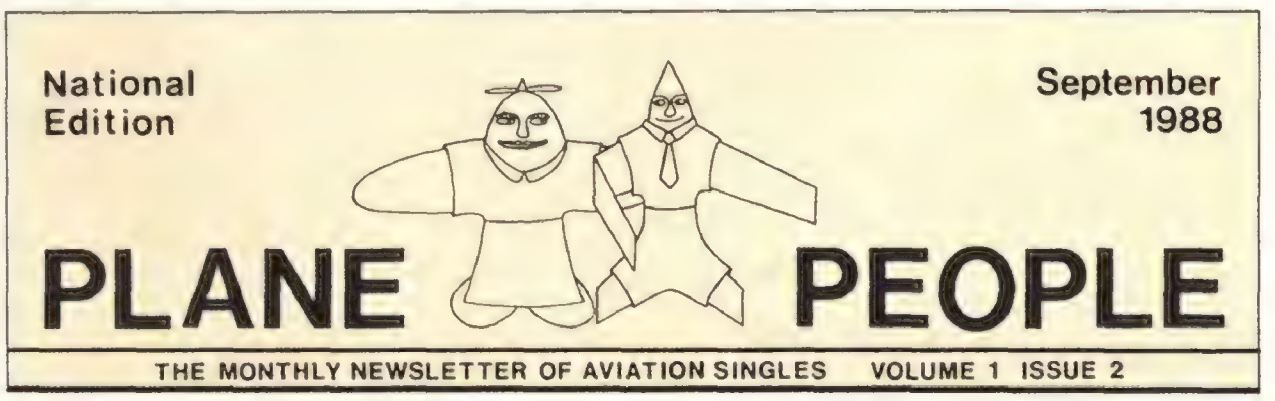
That said, I'll admit that I called Ron Angle intending to trick him into making undignified lonely-hearts confessions. He seemed promisingly Rustian. In *Plane People*'s premier issue he elected himself "Male Personality of the Month," and in an interview with himself said, "When we asked [Ron] to describe his personality, he couldn't answer in a simple fashion. He told us, 'I have a personality that changes with the situation.' "

But when I called Angle I realized I'd erred. He's a nice, lonely young pilot who's simply out to bring people together and maybe meet some nice flybabes himself. Five minutes on the phone with the enthusiastic Angle and you want to rush out, grab the nearest stranger, and sputter, "Ron and his friends keep meeting women who tolerate flying but don't really like it! A NETWORK IS NEEDED!" Unfortunately, his airborne love connection is, so far, about as successful as the Spruce Goose.

"What I'm facing now," Angle says, "is a situation in which I don't feel that the aviation community really . . . *knows* about Aviation Singles." In other words, no one's heard of it. Up to 2,000 copies of each issue of *Plane People* are distributed to airports, but after eight months of operation Angle has only 25 subscribers—not promising for a newsletter that depends on reader participation. And so far the response tallies are grim. Angle's ad got zero, the Bachman's one, and only a few ads have really "scored"—that is, they garnered two responses. One was unreadably gimmicky: *Have Long-EZ will travel ret'd fighter pilot 50 y.o. 185# Fun 'n Sun every year like the south for winter flyins time no problem exchange likes dislikes age no problem wt. and bal. a must.* The other, an obvious piece of wolfbait, read: *Frustrated female flight instructor, 21, has been typed for The Big One. Likes twins or moresomes. Have pillow will travel, will make a Champ pilot out of you!!!* Angle says that right now his biggest problem is a distinct lack of ads from young women.

How about it, young women? How about an ad or two from America's most prominent women pilots organization, the Ninety Nines? After all, it's perfectly in keeping with the tradition your founder Amelia Earhart was justly famed for: flying bravely into a spooky unknown.

*—Alex Heard*


National Edition

September 1988

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THE MONTHLY NEWSLETTER OF AVIATION SINGLES VOLUME 1 ISSUE 2

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**100715. R.E.M.: Green** Orange Crush, Pop Song 89, etc. (Warner Bros.)

**100602. Elton John: Reg Strikes Back** • Elton's 22nd gold album! (MCA)

**264134. D.J. Jazzy Jeff & The Fresh Prince: He's The D.J., I'm The Rapper** (Jive)

**200478. Metallica: And Justice For All** • #1 Speed metal band! (Elektra)

**223559. The Beach Boys: Endless Summer** • 21 timeless hits! (Capitol)

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**105392. Pops In Space** John Williams & The Boston Pops. Music from Star Wars, The Empire Strikes Back, more. (Philips *DIGITAL*)

**153582. Tracy Chapman** Fast Car, Talkin' 'Bout A Revolution, etc. (Elektra)

**164165. Bobby McFerrin: Simple Pleasures** • Don't Worry Be Happy, etc. (EMI)

**244006. Simon & Garfunkel: The Concert In Central Park** • All-time classics! (Warner Bros.)

**125179. Tchaikovsky, 1812 Overture; Romeo And Juliet; Nutcracker Suite** Chicago Symph. Orch./ Solti. (London *DIGITAL*)

**100459. Cocktail (Original Soundtrack)** • (Elektra)

**100604. Heifetz: The Decca Masters, Vol. 1** Golliwog's Cakewalk, Clair de lune, many more. (MCA)

**100035. Robert Palmer: Heavy Nova** • Simply Irresistible, More Than Ever, etc. (EMI)

**123385. The Best Of Eric Clapton: Time Pieces** (Polydor)

**100579. K. T. Oslin: This Woman** • Hold Me, Money, title song, more. (RCA)

**100470. Vangelis: Direct** New Age Meditations, The Motion Of Stars, The Will Of The Wind, etc. (Arista)

**153983. Charlie Parker: Compact Jazz** • Now's The Time, Night And Day. (Verve)

**154135. The Best Of Steely Dan: Decade** 14 hits. (MCA)

**104871. Supertramp: Classics (14 Greatest Hits)** • The Logical Song, Give A Little Bit, more. (A&M)

**144578. The Judds': Greatest Hits** • (RCA)

**115356. Pinnock: Vivaldi, The 4 Seasons** • Simon Standage, violin; etc. (Archiv *DIGITAL*)

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**173406. Jazz CD Sampler** Over 67 minutes of jazz. (Polygram)

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**134321. Led Zeppelin: Houses Of The Holy** (Atlantic)

**153606. INXS: Kick** • Need You Tonight, Devil Inside, etc. (Atlantic)

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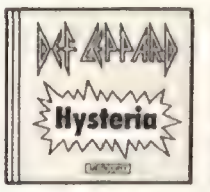


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**270106. An Evening With Louis Armstrong** • (GNP Crescendo)

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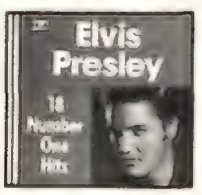


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# Gerry's World

In 1969 Gerard O'Neill posed a startling question: Why live on a planet, anyway?

by Al Reinert

The Princeton University catalog for the 1969-70 school year made Physics 103 sound anything but inspiring: "A course in general physics open to students offering good school preparation in physics and four units of mathematics at entrance . . . . Two lectures with demonstration experiments, two classes, one three-hour laboratory. Mr. O'Neill."

What nobody could foresee was that Mr. O'Neill—Gerard K. O'Neill—would be inspired by the course to change his life, and that from Physics 103 that semester would come not only a bold new field of science but a whole new perspective on life, on Earth and off of it.

O'Neill asked his class a question: Is the surface of a planet really the right

NASA

*Science fiction or future reality? O'Neill believes a space colony could support several million people.*


Rick Guidice

KELLY/MOONEY


*O'Neill thinks that it is in mankind's best interest to find a way to live off the planet Earth.*

place for an expanding technological civilization? The answer he got was, basically, no.

In labs and in seminars, Physics 103 students studied the stuff of science fiction—the possibility that humans could establish long-term colonies in space. How might one grow fruits and grains in a self-contained space habitat? Where would you get fertilizer? How much radiation shielding do Earthly creatures require in solar orbit? What is the total mass necessary, and what would it cost to deliver that mass to the requisite orbit? And perhaps most important: How could they pay for it?

O'Neill even got his teenage children interested in the questions he was asking. "It all sounded very feasible," says Eleanor, now 28, although "we tried to blow holes in the idea, kind of as a devil's advocate and for the intellectual challenge." She remembers thinking that he should have been more concerned about potential conflicts over resources. It shows "what an idealist he is," she says. "People always fight over resources."

What began to emerge was a workable scheme for living well in the endless void. O'Neill detailed it in his 1976 book *The High Frontier: Human Colonies in Space.* Humans could construct huge cylinders in outer space and live inside them. Built of materials mined from the moon or the asteroids, the devices would spin enough to provide artificial Earth gravity at their perimeters. O'Neill's space colony, with room for glazed ham, ballet, rhododendrons, and the joys of low-gravity sex, was a blueprint that plumbers and farmers and accountants could truly believe in. Many have dreamed of mankind learning to live in space: O'Neill made living among the stars seem a matter of mere logistics, something downright natural—even inevitable.

O'Neill traces his "preoccupation" with large-scale problems back to his parents, to whom he dedicated *The High Frontier.* "They were old-fashioned, very strongly dedicated to duty and honor, things that I happen to believe in," he says. "They did a lot of volunteer work, essentially trying to improve the environment they were in. My father was active in reform politics and urban renewal, and my mother was in socially relevant groups such as Planned Parenthood. I was brought up in an atmosphere in which it was proper and appropriate to work on large-scale societal problems."

After graduating from Swarthmore, O'Neill attended Cornell, where he earned a high-profile doctorate by single-handedly rebuilding the school's obsolete cyclotron. In 1954 he arrived at Princeton, where he came up with a design for a special storage ring in which scientists could cause electrically charged atomic particles to collide head-on, thus releasing greater energy. It immediately became the major tool of high-energy physics, earning some academic renown for its inventor but no true sense of fulfillment.

"I think, looking back on it, a certain amount of boredom and frustration was attacking me," he says. "You had to go through a whole process of writing proposals, defending proposals, either being accepted or turned down. And always the business of fighting for grants and all of that. It was just extremely structured. I got pretty frustrated with it by about the mid-1960s."

Then in 1966 NASA announced it was taking applications for scientist-astronaut positions in the agency's proposed post-Apollo science programs. When O'Neill was named one of the 40 finalists, he thought he was in. He started brainstorming possible experiments, coming up with a design for a space-based optical mirror that NASA went on to patent. Then came the awful disappointment—the program was canceled. So two months after the first humans landed on the moon, it was back to physics for freshmen.

This time O'Neill decided to organize his lectures around the theme of space exploration. He gave homework assignments and test questions on rocket thrust and orbital rendezvous ("It's all physics, after all.") To liven things up still more, he challenged his best students with a seminar to explore his question about the suitability of a planet's surface for an expanding technological society.

It was a life-changing, big-hearted question—perfect for a man who rates creativity above discovery. "I just don't get as excited about scientific discovery per se as I am about the idea of creating something," he says. It was a question that forced the questioner to look beyond his expertise. "If I have a talent," O'Neill says, "it is probably in the area of large-scale systems design. It's probably like wiggling your ears; it's hard to say why you can do it. Part of the reason is I tend to think in a very parallel way. If

I have an idea, it suggests 15 other ideas in different and apparently unrelated fields."

It was also a question resonant with romance and wonder, asked in this case by a man who was feeling expansive—a man who was falling in love. Renata (called Tasha) Steffen was a German student of languages who came to America as an *au pair* for the family of George Gallup (of Gallup Poll fame) in Princeton, New Jersey. Ten days after her arrival she met the man who was to change both of their lives. He had just that week begun teaching Physics 103.

"She was sort of present at that creation," says O'Neill, smiling. "The whole idea of going out into space is a romantic idea, and there certainly was a high degree of romance associated with our lives at that point. Tasha surely made a very important contribution to it all. You can't really measure how it happened, but you know it was there." O'Neill married Tasha, his third wife, in 1973; they have an eight-year-old son, Edward.

But romance isn't always contagious. Initially, his papers on space colonization were rejected by every peer-reviewed journal he sent them to, including publications he had written for before.

George Hazelrigg, an engineer at the National Science Foundation, used to be at Princeton and remembers getting a call from O'Neill in 1972, before he had gone public with his ideas. "He said he had an idea to put a lot of stuff in space and he wanted to know what it would cost to do it. NASA at the time was estimating $175 a pound for low Earth orbit. What O'Neill didn't realize was that his orbits were quite different and would be substantially more expensive. The first thing we did was to ask him to come up to the engineering school and give a seminar. He did and told this glorious idea to engineering students." They quickly shot his ideas down.

"It was an awareness thing for him," concludes Hazelrigg. "He came in thinking, 'I'm going to tell them wonderful things they could be doing if only they had the brains to think about it.' He went away thinking, 'Well, there are unsolved questions . . . .' "

A conference on practical problems in establishing a colony in space was held at Princeton in May 1974 and helped turn the tide. A front-page article in the *New York Times* reported that "[a] conference of physicists, astronauts, and space-flight technologists discussed last week the likelihood that it is now possible and, in fact, desirable to establish self-sufficient colonies in space." A few months later, the prestigious journals *Nature* and *Physics Today* published articles by O'Neill on the possibilities of space colonization.

*Revolving to provide artificial Earth gravity at its "equator," this colony would be powered by sunlight.*

NASA

It was an idea that struck world-weary nerves. By the mid-1970s the American space program appeared to be more involved with politics than romance, and the Soviet program was too darkly secretive for casual dreamers. People went back to make-believe. "Star Trek" returned as a rerun phenomenon. Outer space replaced the Old West as the setting for high adventure in movies like *Star Wars.* Science fiction became respectable—books were regularly issued in hard cover and reviewed as genuine literature.

After the publication of *The High Frontier* O'Neill became a celebrity so fast that the memory is still a blur. "I was in some degree of schizophrenia," he says. "I was still working full-time being a high-energy physicist, you know. All this time that was still my job. I'd be in the middle of runs, taking data at some storage ring, and I'd get a call from the "Today" show or something, wanting to know if I could be in New York in two days. I hadn't anticipated any of that."

A new edition of *The High Frontier* will be published this spring. O'Neill wrote a new preface but resisted tinkering with the main text. "My reasoning is that this work both counsels and predicts our future," he writes. "To judge its validity, you as its reader should be free therefore to review the original as the years go on." O'Neill has also written a forecast of the century to come, *2081,* and a book dealing with current trends in corporate growth and success, *The Technology Edge.*

At 62, O'Neill looks much the same today as he did in his celebrity period. The chestnut hair is a little gray now but still cut in the same '60s-style bangs. He still wears turtleneck sweaters and tweed jackets. He seems quite content, talking in a soft unhurried voice that relaxes a listener, encourages dialog,

and promotes clear thinking.

All is not well, however: in 1985 he was diagnosed as having leukemia. "April 1985," he says, "April 29." At the time, the doctors said he had 18 months to live. He describes the illness, as one of his doctors did, as "a smoldering fire."

"At this stage of the medical art," he says matter-of-factly, "it is not a curable disease .... If I could think of a good systems design approach to this, I'd be doing it. What I do is bring to bear the simple-minded skills—how to graph and analyze data—in an attempt to help my doctor decide how much medicine to give me and when." O'Neill also tries to keep up on the latest advances at the U.S. National Institutes of Health and other medical research centers.

The success of *The High Frontier* enabled O'Neill in 1977 to found the Space Studies Institute, whose purpose, according to its charter, "is to open, for all humanity, the High Frontier of space." The institute promptly became the main clearinghouse for really spaced-out R&D. Funding came from numerous sources—corporate and foundation grants, NASA contracts, individual memberships, plus most of O'Neill's book royalties—and was channeled to research teams at MIT, Stanford, Rockwell International, and the like. The emphasis is on practical knowledge: extracting oxygen and nickel-iron from lunar samples, making optical glass and concrete with meteor fragments, and supercomputing ultra-stable orbits.

SSI also built and tested three generations of mass drivers, the key to low-cost living in outer space. First conceived back in Physics 103, the mass driver is essentially a giant electromagnetic catapult. In theory it can deliver the necessary raw materials to orbital construction sites at energy-saving prices. By actually building three of them over the years, each one bigger and more powerful, the institute not only proved the theory sound but also developed the basic technology needed to advance the dream.

Every step closer to the day of space colonization brings cheers from the folks at the National Space Society. The society includes former members of the

NASA

*Some believe this mile-wide colony, constructed from moonrock, could be built with existing technology.*

L-5 Society, conceived at a 1975 Princeton conference and dedicated to O'Neill's principles of the development of space (see "High Society," October/November 1988). Its goal was a convention at Lagrangian point 5, a stable point in the Earth-moon system that O'Neill had suggested as a logical spot for a human space colony. (O'Neill himself was much relieved when L-5 merged with the more respectable National Space Institute, a lobbying group, to form the National Space Society. Like other prophets, he found some of his followers slightly embarrassing.)

But O'Neill's celestial brew didn't suit everybody's teacup. Social commentator Lewis Mumford flatly stated: "I regard space colonies as another pathological manifestation of the culture that has spent all of its resources on expanding the nuclear means for exterminating the human race. Such proposals are only technological disguises for infantile fantasies." Senator William Proxmire, known for holding scientists up to ridicule with his Golden Fleece Awards, was more succinct: "Not one cent for this nutty fantasy."

Carl Sagan, an outspoken proponent of a place for man in space, disagrees on the particulars of O'Neill's vision, especially O'Neill's championing of the eco-

nomic development of the solar system. During a 1985 public meeting of the National Commission on Space, Sagan said, "My personal view is that the exploration of space should be done on behalf of the human species and not on behalf of the profit motive of a few people who are not beholden to the rest of the human community."

The chairman of the commission was Thomas Paine, a former NASA administrator. "It was a lot of fun" to work with O'Neill, says Paine, but he adds goodnaturedly that "there were times I could have throttled him. Gerry is one of those real impossible genius types. Creative people tend to be loners and tend to get very impatient with people who don't go along with the world as they see it. Gerry's a genius, no doubt about it. He's pushing, pushing, pushing . . . in contrast with the standard, 'We tried that before and it didn't work.' "

In 1983 O'Neill brought his talents to the business world when he founded the Geostar Corporation, based on the premise that outer space was ripe territory for human entrepreneurial activities. The company's goal was to build the Geostar satellite system, which O'Neill had patented the year before but had conceived in 1978, a few days after a midair collision occurred over San Diego. "Officially it was called pilot error," he recalls, "but really it was a system failure."

O'Neill himself was a pilot by this time—a diamond-badge soarer—and the tragedy got him wondering how to design a foolproof system for inflight tracking and guidance. It became his new hobby. After his usual meticulous, obsessive study, he devised a system of geosynchronous satellites, ground computers, and individual mobile transceivers. It was analogous in its purpose to the Navstar system developed separately by the defense department, the crucial difference being that O'Neill's concept was simple and cheap.

But the government wasn't interested, so O'Neill turned to private investors. He assigned 85 percent of his founder's shares to the Space Studies Institute, took a leave of absence from Princeton, and became a corporate president.

Today there are two Geostar relays already in orbit—piggybacked aboard GTE satellites lofted on Ariane launchers—and the first three dedicated Geostar satellites are nearly finished at the RCA plant south of Princeton. All three are on the manifest for a future shuttle launch. The company's biggest customers so far are long-haul trucking services, which can now locate and direct their transceiver-equipped trucks with new precision and economy. The foolproof system of air traffic control is still in the picture, too, but off in the future.

"I've loved my adventures in the business world," says O'Neill. "Starting companies is the most fun I've ever had professionally." He says this from his small off-campus office in Princeton, the headquarters of his new venture, O'Neill Communications. It is based on another O'Neill invention, a kind of wireless intercom that came to him when he was hospitalized in 1985. "The doctors and nurses all had these beepers and pagers that never seemed to work right. They had tremendous difficulty trying to communicate with people who were in the same building. I just thought that there had to be a better way to handle it."

O'Neill intends to resign from the management of O'Neill Communications in June of this year. "I've promised both the financing source of OCI and my family that I'm not going to start any more companies," he says. "I have books in mind and a lot of work I want to do for the Space Studies Institute and OCI as chairman, but not in active line management."

Looking back, there is no question in O'Neill's mind about his most significant achievement. "The development of the space colony concept is what I hope to be remembered for," he says. "That is still by far the most important work I've done in my life."

Will O'Neill's vision come to pass? Not in the next couple of decades, according to Allan Ladwig, director of special projects at NASA's office of space exploration, "unless there is radical change. But in 50 or 75 years—I'd be surprised if that sort of thing didn't happen." In any case, he says, it's important for non-governmental groups to keep throwing out ideas, even if they exceed what is currently practical. "NASA is 30 years old," Ladwig says, "and not quite as open to change as it was in the '60s. There is a certain 'not invented here' syndrome that starts to float around; we need these groups out there doing creative things."

Being "out there" seems the inevitable position for O'Neill, who is "always building things," according to his daughter Eleanor. "Last summer it was a motor mount for a small boat," she says. "And when we were quite young and camping, he built a winch to get a small sailboat onto the top of the car. He'll invent things just for the spur of the moment. You don't go out and buy a component at the hardware store. You take wood or whatever else is around and make it work." ✦

ANDREI SOKOLOV

# ЭНЕРГИЯ

## The Soviet Union's Energia is the biggest rocket in the world—but what's it for? One Soviet and three American experts suggest jobs for the big booster.

## WE'VE GOT THE COSMOS IN OUR HANDS

by Mikhail Chernyshov

The Energia super rocket, first launched on May 15, 1987, has notably broadened the Soviet Union's opportunities for exploring outer space. In our space programs, we do not rely on one single launch system. On the contrary, missions to explore space are planned around the entire range of expendable rockets, in addition to the reusable Buran shuttle. The launching of communications, weather, and other "standard" satellites will be accomplished by ordinary one-time rockets. The use of the Energia-Buran system for such launches would be inadvisable, in the opinion of Yuri Semenov, Buran's chief designer.

But with the addition of the Energia-Buran system, we see a space industry emerging in the Soviet Union before our very eyes. We will now have enhanced operations with the Mir space station, placed in near-Earth orbit in 1986. We will have the ability to retrieve objects from space. And we will have the load lifting capacity of the Energia, which can now place a 100-ton payload in low orbit. However, that is not the limit. More strap-on boosters could be added in conjunction with a variety of upper stages, and this will make it possible to surpass the present capacity substantially.

According to Alexander Dunayev, head of Glavkosmos, the agency with responsibility for commercial activities in space, the Mir station will achieve its complete four-module configuration in 1991. "According to our plans," Dunayev says, "Buran shuttles will work in tandem with that orbiter [space station] by way of experiment. Mir and its specialized modules will make it possible to check all fundamental aspects of the production of semiconductors, biological preparations, medicines, and other valuable products in orbit. Using our findings, we will decide matters related to the development of an orbiter of the next generation."

It is believed that future space stations will be built of heavyweight elements, not the one- to 12-ton components used at present. This is exactly where Energia's powerful reserve will be most useful.

Buran can also accomplish the task of retrieving objects from space under the present plan. The Salyut 7 space station could possibly be returned from orbit between 1995 and 2000. The station was manned between 1982 and 1986 and was transferred afterward to a higher orbit. Currently it is undergoing a service-life test of sorts. Its return will give experts extremely valuable data about its performance.

Again, Buran designer Yuri Semenov

NOVOSTI FROM SOVFOTO

SOVFOTO


*Energia and the Buran shuttle bear a striking resemblance to another space transportation system.*

believes that using Buran to retrieve satellites would not always be economically viable. However, certain unique objects, such as satellites with nuclear powerplants, should by all means be retrieved from near-Earth orbits after their service lives are over in order to prevent the radioactive contamination of Earth and near-Earth space.

There is no doubt that the time will come when solar power plants will be built to ensure power supply to orbital manufacturing plants. These will be vast energy fields. To build them we will have to transport unfolding structures, films, and other materials to space orbits. Gury Marchuk, president of the USSR Academy of Sciences, believes that for that purpose we will need the capacity of the Energia rocket. However, its name (meaning "energy") was not chosen to reflect such projects.

Energia will also participate in large-scale programs of international cooperation. If a manned flight to Mars is ever made, Energia, in combination with Buran, can make a valuable contribution to the project.

The Soviet space program has developed a strategy in its advance to Mars. This year we are carrying out the Phobos international project. The mid-1990s will probably witness the delivery to Mars of special vehicles and balloons for the study of the Martian atmosphere. In the late 1990s we will probably bring the first samples of Mars soil back to Earth. All preliminary operations will be accomplished by automatic systems, and then it will be possible to start preparations for a manned flight to that planet.

There are many plans for the flight from Earth to Mars and back, and at this time it is too early to examine any specific flight plan. One thing is clear: it will not be a direct flight from one planet to the other. The project will require that the mass of the interplanetary spaceship will be (and, in all probability, exceed) 450 tons. It is possible to assemble such a system in a near-Earth orbit using individual units delivered to space by the Energia rocket or the Buran shuttle. If the Mars project ever becomes a reality, there will be plenty of jobs for Energia and Buran—and for U.S. shuttles, for Hermes, and for new spacecraft that are now in the development stage.

*—Mikhail Chernyshov is a science writer with the Novosti Press Agency in Moscow.*

## IF AT FIRST YOU DON'T SUCCEED . . .

by Saunders B. Kramer

With Energia the Soviets can place about 20 tons in geosynchronous orbit, send 35 tons to the moon, put 31 tons on a path to Mars, and shove a substantial portion of that weight to Pluto or any other planet in the outer solar system. Ready or not, those are pretty impressive payloads.

Energia is the culmination of an effort, spanning 20 years, to build a rocket big enough to send a manned spacecraft directly to the moon. The failure of that effort lost the space race for the Soviets

in the 1960s and forfeited their claim to technological superiority. The Energia proves that they learned from their mistakes and from a few of ours as well.

The SL-15, or G, rocket, which was to have carried cosmonauts to the moon, was a giant. Satellite photographs of its 1969 launch site indicated that the first stage was 48 feet in diameter. The diameter of the Saturn V first stage was about 33 feet. The G, however, was not like its successful Sputnik-launching predecessor, the Vostok.

After World War II, Soviet engineers, like their U.S. counterparts, were testing and learning from German rockets. The Vostok differed from German designs, however, by using strap-on engines as an initial stage, with the second-stage engines in the central core. For later missions, a third stage was added on top of the second.

The G rocket had no strap-ons. It was a straightforward, staged, tandem booster, similar in general design to the Saturn V. The Soviets made three attempts to launch it. The first rocket exploded on the pad, leaving a huge, black, elliptical scar that was photographed by reconnaissance satellites. The second blew up at about 26,000 feet, and the third made it to 40 miles before it, too, exploded.

One tale that floated out of the intelligence community was that the vehicle used pressure-fed propulsion tanks, which, upon ignition, induced a pogo stick-like vibration that tore the vehicle apart. Little appears in the public record to confirm this theory. The Saturn V also experienced such vibrations, although they were not as severe; some minor design changes eliminated the problem.

The magnitude of the research and development effort that went into the construction of the Energia is a measure of the Soviets' determination not to repeat the mistakes that doomed the G booster. New steels and alloys of aluminum and titanium were invented specifically for the launch vehicle. They make up 70 percent of its dry weight. Five full-scale test vehicles were constructed—the Saturn V had only one such model—and 6,500 tests were conducted either on the models themselves or on their subassemblies. Two hundred major experimental installations were made to test operations like fuel delivery and stage separation. Thirty-four large structural assemblies were built and tested.

Rather than design and build gargantuan engines, such as the Saturn V's F-1s, the Soviet designers decided to distribute the required thrust among four engines for the core stage and to use strap-ons again. Each of the four strap-ons has one engine with four nozzles. A useful rocket all on its own, the strap-on stage doubles as the SL-16 launch vehicle. This launcher had its own lengthy series of tests, culminating in the placement of electronic intelligence satellites in Earth orbit. The Soviets plan to increase Energia's payload capability by adding two or perhaps four more strap-on boosters.

In addition, while the Soviets were designing Energia, they read about the U.S. shuttle and its launching methods—information that was available in many publications—and studied its performance. The Soviet team was quick to recognize that the customized configuration that had evolved in the United States had only one use: to launch the shuttle. By deciding to move the engines from their shuttle orbiter to the core stage, the Soviets created an ingeniously versatile heavy-lift launcher.

The shuttle launching system and the current configuration of the Energia have comparable payload capabilities. The Energia lifts about 116 tons and the U.S. shuttle lifts about 123. But 97.5 tons of that 123 *is* the shuttle. In the Energia design, any of a wide variety of payloads can be attached to the huge cylinder containing the liquid hydrogen and liquid oxygen propellants. The SL-16 strap-on makes the arrangement even more versatile: used as a separate booster, it can place at least 13 tons in Earth orbit.

The Energia has recovered for the Soviets the confidence that the G booster disasters took away. The simple answer to what Energia can boost now is the international prestige of the Soviet Union. And why not? In the 1960s John Kennedy tried the same thing with Apollo, and it worked for him.

*—Saunders B. Kramer has been studying and writing about the Soviet space program since 1957.*

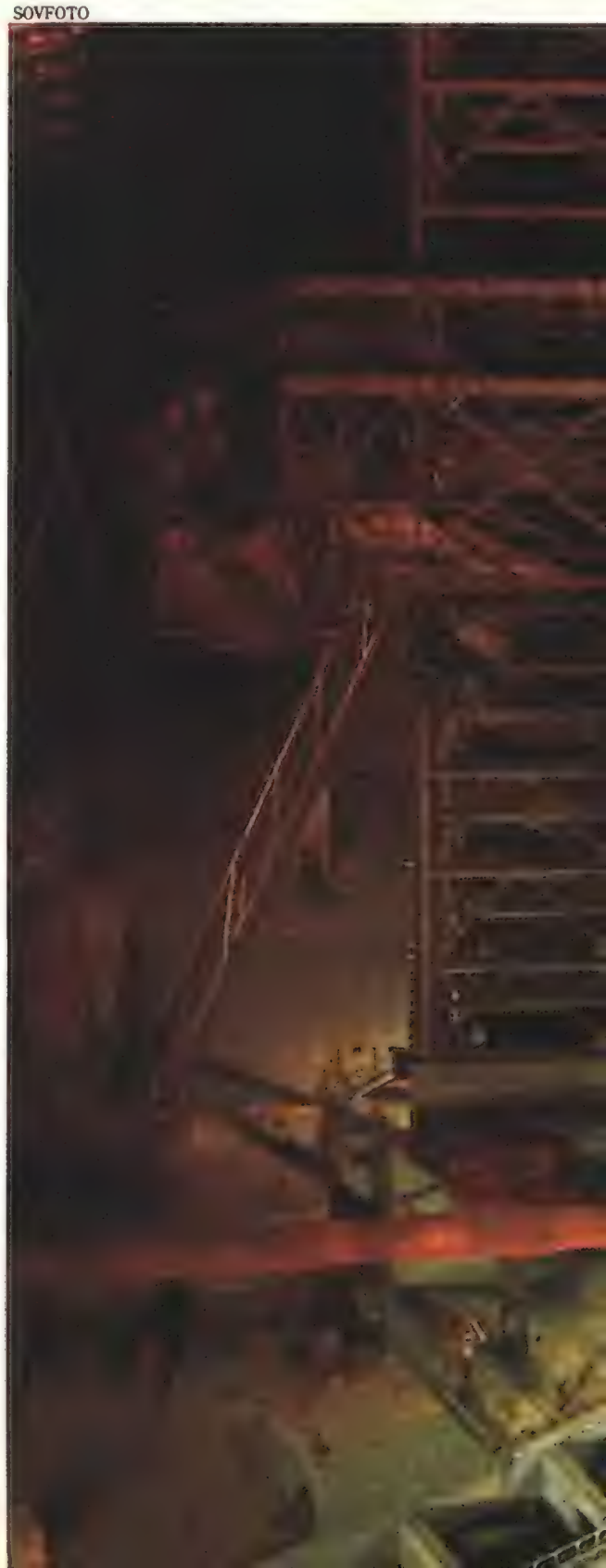
## A ROCKET AHEAD OF ITS TIME?

by Marcia S. Smith

*Glasnost* has opened some areas of the Soviet space program, but many developmental programs are still not public. To some analysts on the outside peering in, it may appear that Energia was developed simply to prove that Soviet engineers could build a heavy-lift vehicle following the embarrassing failures of the G rocket. But it is also possible that the Soviets are developing space systems, unknown to us, that require Energia's capabilities.

Based strictly on public Soviet statements, it is difficult to identify missions that justify the introduction of Energia

SOVFOTO



at this time. The Soviets have announced that they intend to launch Energia only two to four times a year. This number presumably includes the Soviet space shuttle launches, the only apparent use for Energia now. The shuttle, they say, will be used to return to Earth specialized research modules that will dock with the space station Mir. Mir has four extra ports to accommodate these modules for research in materials processing, remote sensing, or medicine, but none has been launched yet. Kvant, an astrophysics module, was added in 1987, but it is not docked at one of the ports and apparently is a permanent part of the station. Returning Mir modules will not make demands on the Energia launch rate any time soon.

Other missions announced by the Soviets are all long-term plans. Launching construction materials for solar power stations, which would generate electricity for space factories, is one example. Materials processing on an industrial scale will require substantially more electric power than is currently available aboard Mir, for example, which operates in the 10-kilowatt range. But with the information that we now have about the project, it appears that such a power station will not be ready before the mid-1990s.

Soviet space scientists have outlined proposals for missions through the year 2000, but none requires Energia. In fact, the Soviet space science community, which has been more forthcoming about its projects than the other branches of the space program, seems unenthusiastic about the giant booster. At the International Seminar on Future Studies at Mars, sponsored by the Space Research Institute (IKI) in Moscow last July, it was not the scientific community that came forward with a plan for incorporating Energia. It was Glavkosmos, the agency that coordinates the use of Mir and now, apparently, the new rocket. At the same seminar, a competing plan relying on the old Proton booster was recommended by the Babakin Institute, an engineering research center that developed the two Phobos spacecraft. How great a conflict exists between Glavkosmos and the science institutes is difficult to discern from the outside. But at least one prominent scientist, former IKI director Roald Sagdeev, has openly criticized the Soviet shuttle and the institutions responsible for its development.

*The champ weighs in, with companion, at 2,640 tons, about 400 tons more than the U.S. system.*


Since last July, many of the proposed scientific missions discussed at the seminar have been pushed farther into the future. For example, the mission named Mars 94, originally planned to carry a rover, may become Mars 96, a delay that could postpone other proposed missions. Even if the space scientists warm up to Energia, they won't be ready to use it until the mid- to late 1990s.

Perhaps space systems were planned in the 1970s that would have required Energia, but the programs were canceled for technical or budgetary reasons. More intriguing is the possibility that the Soviets did pursue these projects but have not revealed them. We know little of Soviet programs in such fields as communications or reconnaissance, not to mention space weapons. Undisclosed programs in any of these areas could explain the need for the three Energia launch pads and "several" shuttles in construction, requirements that are not otherwise apparent.

*—Marcia S. Smith is a specialist in aerospace policy for the Congressional Research Service of the Library of Congress. The views expressed here do not necessarily represent those of the CRS or the Library of Congress.*

# MAKE MONEY, NOT WAR

by James E. Oberg

When the Soviets announced the test of their new monster rocket in May 1987, claiming it would "put in orbit reusable spacecraft and *other heavy space vehicles*" (emphasis mine), Western observers got nervous. U.S. defense department investigations had turned up no communications or science satellites heavy enough to require the 100-ton launch capability of the Energia, and Soviet secrecy about what the rocket would launch naturally led Western intelligence agencies to suspect a military connection.

Now, two years later, after a flood of information about Energia and its job as a shuttle launcher, the experts interpret this secrecy differently: the Soviets aren't saying what these other payloads will be because they don't know themselves. The decision to build the multi-billion-ruble space transportation system was made about 1974 by the Brezhnev gerontocracy. When you remember that the same brain-dead regime planned to deploy SS-20 missiles in Europe while effortlessly annexing Afghanistan, you may find it easier to believe that Leonid Brezhnev could start building a rocket without a payload in mind. By the time Mikhail Gorbachev had a chance to be briefed on the project, most of the money was already invested. The challenge to Gorbachev is to make the investment pay off.

The record-setting Energia is not only the world's most powerful rocket, it is also the world's most expensive. The Soviets have not been forthcoming about what they spent to develop the booster. Considering the technological challenge and the size of the construction project for ground support, the cost must be very close to what NASA spent on the Saturn V: $20 billion (in 1989 dollars) for the rocket and at least $5 billion more for the ground facilities. (The Buran shuttle cost at least another $8 billion.)

Unlike the U.S. shuttle system's, Energia's components are all expendable. According to Academician Yuri Semenov, the chief designer of the Energia-Buran system, the Soviets took this course because hardware reusability is not economically justified. "Bringing the booster rocket to the point where it can be used repeatedly is a complex and expensive task," he correctly cautioned an American reporter late last year. The major cost of launch, of course, is not metal but people, the ones who do the pre-launch checkout and servicing. And it is an even more expensive operation for used hardware than for new. Even though Energia's first stage, the cluster of strap-on boosters, was designed for reuse, Semenov said that there are no plans to use the ones that have already flown. "Reuse requires expensive work, which virtually cancels out the savings," he concluded. NASA has been able to make a reusable system cost-effective only because it can spread the cost over six to eight launches a year, rather than Energia's proposed yearly rate of two to four.

Although the Soviets have not disclosed launch costs, officials of Glavkosmos, the agency that markets Soviet spaceflight services both at home and abroad, have announced preliminary charges for foreign customers. According to Arthur Dula of the Houston-based Space Commerce Corporation, which handles Soviet space services for Western customers, the price of a dedicated launch on Energia is about $400 million. The actual cost is probably closer to that of a Saturn V launch, $600 million in today's dollars. The rubles spent providing the service, however, have a much lower value than the dollars that would pay for it. For the Soviets, that $400 million in hard Western currency would be a bonanza.

An Energia launch will cost the customer ten times the price of a Proton launch. Since Energia's payload capacity is only five times greater, its cost per pound is twice that of the tried-and-true Proton. Even a shared launch on Energia would be considerably more expensive. The only practical use of the superbooster is for payloads that are simply too large for the Proton.

This significantly reduces the field of candidates. Manned flight beyond Earth orbit (to the moon, to be precise) and a heavy space station were the only two uses of the enormous Saturn V. NASA would like to have a shuttle-like cargo vehicle for the same applications in the late 1990s. The Strategic Defense Initiative Office envisions using heavy boosters to launch orbital battle stations but won't have the weapons to arm them before the turn of the century.

*The Soviets trusted Energia enough to send their multi-billion-ruble shuttle on the rocket's second launch.*

What are the Soviet equivalents of NASA and SDI payloads? Enthusiastic Soviet spokesmen often point out that their large Mir 2 space station will need a ride on an Energia, but they also admit that this follow-on station is still in the design stage and won't be ready to launch until the last years of the century at the earliest. Similar handwaving about cosmonauts flying to Mars places that event in the next century. And despite Pentagon suspicions about military uses for Soviet space technology, nobody in the defense department has conjured a practical use for a hundred-ton Soviet military satellite anywhere in the near future.

Of course, if the Soviets do not have one great big payload for Energia, they could use it to launch a bunch of small ones. A single launch could carry a year's supply of communication satellites or the entire system of GLONASS navigation satellites—global positioning constellations intended to be similar to the U.S. Navstar system. It took the Soviets eight launches over four years to get the current set of 11 in orbit. Of course, if the launch failed, it could also set the program back four years.

The first big commercial payload for Energia could be Freedom, NASA's earthbound space station. With the cost of two dozen shuttle launches already climbing into the billions of dollars, the Space Commerce Corporation is offering a bargain: the Soviets will launch Freedom aboard two Energia missions for well under half the cheapest cost NASA could manage. This attractive deal could be a mutually profitable proof that supply-side economics may work on the space frontier.

*—James E. Oberg is the author of* Red Star in Orbit *and* New Race for Space. *His most recent book is* Uncovering Soviet Disasters.

# HELL-BENT FOR leather

## Senators, filmmakers, admirals, and fashion designers have all played parts in the saga of the flight jacket.

by Derek Nelson and Dave Parsons


NASM

*Issued as a utilitarian item, the leather jacket quickly evolved into a billboard.*

When the 1988 Department of Defense budget came up for congressional approval in the fall of 1987, one item in particular—53,000 leather flight jackets for the Air Force—was shot down quickly. Both the House and the Senate appropriations committees nixed the buy, a staffer explains, because they felt the $7.4 million worth of jackets was "expensive and frivolous" and unduly benefited only a tiny segment of the military forces. "The Air Force lobbied very hard," she recalls. "It was their number-one issue, believe it or not."

In the final budget, dozens of programs suffered deep cuts. Flight time, the training hours dear to the hearts of aviators, was trimmed by $167 million. But the Air Force got its leather jackets.

The classic flight jacket has always led a charmed life. The two most popular models—the old Army Air Corps A-2 and the Navy G-1—have repeatedly survived the assaults of nylon and other synthetics and dodged the attacks of those factions within the military less prone to nostalgia. In the civilian world replicas are a big hit—people buy them simply because they look cool.

The first military aircraft had open cockpits, and heaters were either nonexistent or crude. Fliers soon learned what auto racers and motorcyclists already knew—that coats made of leather shielded against the wind and were superbly durable. When Lieutenant Theodore Ellyson, the Navy's first aviator,

ED CASTLE/SMITHSONIAN BOOKS

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THE RUDY ARNOLD COLLECTION/NASM

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*Leather flight gear spanned two world wars (top) as the uniform of choice for military fliers, including Chuck Yeager (above) and Hap Arnold (right). Civilian pilots like Amelia Earhart (center) also favored it.*

made flight gear recommendations in 1911, he listed rubber boots, a helmet with detachable goggles and ear coverings, and a leather coat. Other aviators improvised with off-the-rack garments or hired a tailor until the coats began appearing on military equipment lists in 1918.

Heaters and closed cockpits evolved as airplanes began to fly higher and faster during the 1920s, but leather was still the material of choice for flight gear. In the fall of 1930 the Air Corps went looking for a lightweight jacket to replace the A-1, an olive-drab capeskin leather jacket that had been issued since 1927. Working to Air Corps specifications, Aero Leather Clothing Company of Beacon, New York, turned out the A-2. Made of seal-brown horsehide, which was readily available at the end of the horse-and-buggy era, it had a tough can-do look but was comfortable and light enough for casual wear. The A-2 featured a leather collar, brown knitted cuffs and waistband, a light brown spun-silk lining, and a zippered front. It also had patch pockets on the front, decreed by the military brass, says Bill Dasheff, author of *Good Garb—A Practical Guide to Practical Clothes,* so that fliers couldn't stand around with their hands jammed in side slash pockets looking like thugs.

The Army Air Corps officially adopted the A-2 in May 1931, not only because the jacket was well suited to a cold and cramped cockpit but also because it looked good with a uniform. It was a final glimmer of a military style that dated back to a time when gaudy braid, stripes, and plumes weren't reserved for dress uniform but exemplified what Dasheff calls "the visual image of the fighting man." The A-2 was an instant hit with aviators, who painted pictures of airplanes, girlfriends, and pinups on the back and sewed rank insignia, Air Force and squadron patches, American flags, and name tags on the epaulets, shoulders, and front.

The Navy turned to the Willis & Geiger company for its own version in the late 1930s. The New York-based haberdasher had outfitted Navy commander Richard Byrd's Antarctic expeditions in the late 1920s and had made high-altitude flight suits for the Army Air Service. Though the Navy's G-1 lacked epaulets, it closely resembled the A-2, but back vents and a mouton collar made it more comfortable—the A-2's horsehide collar chafed the neck as the wearer swiveled his head searching for enemy aircraft. And the Navy opted for the more durable goatskin, in part because it had the supply ships to import the skins from Persia and Afghanistan.

The explosive growth of the war effort led to the jacket's first brush with official oblivion. Between 1938 and 1941, the number of pilots completing military training rose from 300 a year to 2,750 a month. Army Air Forces suppliers projected a drastic shortage of leather, so commanding general Hap Arnold ordered the jacket into retirement during a conference on procurement in May 1942. "We don't need leather," he announced, tossing the much-loved A-2 on the floor with the rest of the rejects. "Get something better." In April 1944 the gabardine B-15 jacket was issued as a replacement.

The nylon jacket, which debuted after the war, was poorly received. "All of us hated it," recalls Burt Avedon, a former Navy pilot who was issued a nylon jacket during a shortage of leather. Nylon did

BILL FITZ-PATRICK/WHITE HOUSE

*Nancy Reagan's G-1, issued during her tour of the U.S.S.* America, *turned heads in the President's Ward at Naval Medical Command.*

NASM

CAROLINE SHEEN

*In 1943, Flying Tiger Don Lopez posed with his A-2 and Curtiss P-40 in Hengyang, China. Today daughter Joy covets the jacket, which Lopez gave to the National Air and Space Museum for an American Volunteer Group exhibit.*

FREDRIC WINKOWSKI COLLECTION (2)



*Since the 1920s the media has been captivated by the jacket's mystique and its wearers' feats.*

terrible things in a fire, he recalls. "It was extremely unsafe—it would burn against you and weld to your skin instead of burning outward like cotton. You perspired like holy hell—it did not breathe—and the static electricity would drive you crazy." Avedon took over as president of Willis & Geiger in 1978, and when the Air Force returned to the A-2, it turned to Willis & Geiger for specs. "Leather says more about flying," Avedon says. "It is symbolic of the wonderful days of derring-do," a symptom of "the Roscoe Turner syndrome."

The Navy stuck with leather until 1978, when skyrocketing costs and dismal inventory control—there were more jackets distributed than there were aircrew—resulted in a four-year moratorium on the G-1. "We went to a green nylon version," says Navy supply systems analyst Donna Tierney, "but [then Navy Secretary John] Lehman was an aviator, and he decided that the Navy couldn't live without leather. I don't think there is anything we treat quite so specially." Lehman, an A-6 Intruder bombardier-navigator and helicopter pilot in the reserves during his tenure as Secretary, resurrected the G-1 for its symbolism and its ability to create what he calls a tighter fraternity of Naval aviators. "It is an earned eliteness," he remarks.

Today's Navy fliers receive their jackets after their 10th week of flight school at Pensacola Naval Air Station in Florida; the occasion is marked by a flurry of requisitions, receipts, certificates, checkpoints, and audits, all part of a flight jacket tracking system. Every G-1 issued is recorded by stock number and size along with the recipient's name, rank, and social security number.

The jackets are both esteemed and disdained by the higher-ups. Detractors

NASM

*Leather suits warmed high-altitude fliers like the Army Air Corps/ National Geographic balloon crew that surpassed 60,000 feet in July 1934.*


Button Nose

NASM

*Just when the A-2 jacket reached full flower, a leather shortage resulted in its retirement. The Army Air Forces fought the rest of World War II in gabardine, then switched to nylon. (Canines stuck with fur.)*

FREDRIC WINKOWSKI


NASM


*The stars of the 1930 classic* The Dawn Patrol *worked up a sweat in their World War I leather coats during filming in California.*

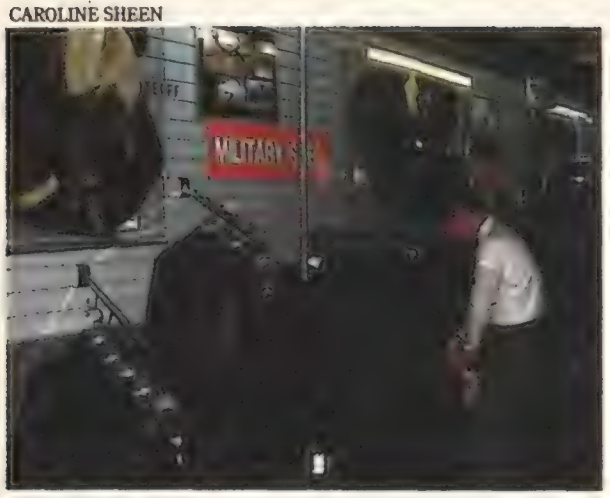
say that the jacket—which is not listed as part of the official uniform—should be considered similar to the flight suit and worn only in the cockpit. (The scuttlebutt is that the submariners and black shoes—the non-flying officers—are just jealous.) In the late 1970s, squadron skippers at the Miramar Naval Air Station in California had to stand a day of guard duty if any of their pilots were caught wearing the jackets on base. Lehman, infuriated when Pensacola gate guards ordered him to remove his jacket in 1976, fired off an instruction within a week of his induction as secretary of the Navy in 1981. It authorized flight crews to wear their jackets wherever they damn pleased.

Lieutenant Commander Bob Norris, a Navy F-14 pilot, says his jacket regularly drew fire when he flew Air Force F-15s on an exchange tour in 1985. Some senior officers challenged his wearing it with khakis, so he began carrying Lehman's authorization in his pocket. Other Air Force officers wanted to know where they could get one. "If I'd had an extra leather jacket during my tour," Norris says, "I could have traded it for an F-15."

Air Force crews were thrilled when Secretary Edward C. Aldridge put leather back in their cockpits last year, not because of the jacket's practicality but "to improve *esprit de corps*" among fliers, says Air Force spokesman Lou Figueroa. The media, however, interpreted the move as an attempt to improve retention rates. "That was never the idea," says Figueroa. "If somebody makes a career decision based on a leather jacket, we're in trouble."

The commercial market for both original and replica jackets was booming long before the Air Force resurrected the A-2, with adventure movies like *Indiana Jones and the Temple of Doom* and *King Solomon's Mines* triggering a

CAROLINE SHEEN



NICHOLAS GAMARELLO


*Shoppers can buy an ungarnished A-2 or G-1 replica off the rack for about $350 (top)...*

*...and artist Nicholas Gamarello can personalize it with memories real or imagined.*

NASM


Top Gun *boosted sales of Navy G-1 replicas briefly in 1985, but the Air Force A-2 model soon regained its customary lead.*

rush of sales. According to Mark Weitzman of Western Costume in Hollywood, "The number-one jacket for adventure movies is the A-2," preferably aged. The same held true for clothing stores—until *Top Gun.* In 1985, says Jim Wegge, president of Flight Suits Ltd., the A-2 outsold the G-1 by about four to one, but when Tom Cruise strutted his stuff in a Navy jacket a year later, G-1 sales soared. After the dust settled, however, the Air Force version was back on top.

"The jackets are everywhere," says Mark Greenberg, director of creative services for The Cockpit, a mail-order firm that sells aviation clothing and flight gear. "And they range from the very authentic to the barely recognizable." Flight jackets have been appearing in the ultra-traditional L.L. Bean catalog since 1975.

Armies of civilians, most of whose flight time has been logged in coach class on a 727, spent $50 million on leather jackets in 1987 for the same reason that the makers of *Raiders of the Lost Ark* chose an A-2 for its star, Harrison Ford: image. "They were the fighter pilot jackets of an era we now remember with great nostalgia," says Bill Dasheff. "The pilots were part of an American tradition—independent, full of nerve and bravado, the center of attention. They did a dangerous job, one that took brains and guts." Today, those who can't, wear. "The flight jacket has become part of the culture, like the cowboy hat," Dasheff concludes.

Dasheff estimates that an ungarnished World War II A-2, in presentable condition, would easily run $350—about the same as an off-the-rack replica. Lee Herron of Aviators World in Mojave, California, sells a couple of originals each month for up to $600. Mark Greenberg says that a couple of years ago friends had found customized World War II jackets for a few hundred dollars at gun shows. "Now that they're much more trendy, hand-painted A-2s are selling for $1,000 to $1,500."

The problem with original jackets, of course, is availability. "When they come in they don't stay around very long," says Dave Richmond of National Capital Historical Sales in Springfield, Virginia, one of the largest retailers of historical military equipment. Some customers are collectors who wouldn't think of wearing the jackets, Richmond says. Others "just like them because they're nice jackets" and clearly intend to wear them. "And we get some veterans who regret losing their own jackets and want another one."

Don Lopez, deputy director of the National Air and Space Museum, gave up his A-2 in 1975 for the Museum's display honoring General Claire Chennault and the American Volunteer Group. The jacket, with patches for the 14th Air Force, 75th Fighter Squadron, and China-Burma-India theater, would have brought a small fortune on the open market, but Lopez felt it was a piece of history better suited to a museum. His A-2 had also begun to show its age—Lopez had stored it in a trunk—but he knew that the museum could save it. "Now my daughter is giving me a hard time because she'd like to have it," he says.

The Space Age may eventually produce a garment that will epitomize the conquest of the final frontier. But the leather jacket has weathered six decades of fickle fashion, and its mission seems far from over.

*Today both nylon and leather coexist peacefully aboard the aircraft carrier* Constellation.

DAVID HATHCOX/PHOTO PRESS INT'L. LTD.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# When in Paris...

## . . . do as the airshow veterans do. And bring money.

by F. Clifton Berry Jr.

*Photographs by Peter Menzel*

*The Paris Airshow is the premier showcase for aerospace; the food and drink make it a catering expo as well.*

TO: Accounting

FROM: Marketing

RE: Paris Airshow Expenses

This memorandum is in response to your request to justify "extraordinary and unusual expenses claimed" by this department at the Paris show. Background material is provided so that those in Accounting can better understand the special circumstances that prevail at this important industry event.

ITEM: Five persons attended, whereas three suffice at most shows. Explain the discrepancy.

*The centerpiece at Paris is airplanes—the newest, fastest, and loudest. A U.S. Air Force B-1B performs a low pass.*

*The art of the deal is practiced in quiet corners of corporate hospitality centers called chalets.*

The rationale for participating in this 10-day international exhibit and tradeshow has been debated for years by various companies pondering what they get in return for the high cost of attending. The most important reason is basic: the Paris airshow is the world's largest aerospace exhibition.

In 1987, about 1,465 exhibitors displayed their wares before a total attendance of half a million people. The show is held in odd-numbered years (the 1989 show will run from June 8 to 18) at a permanent site at Le Bourget, an airport located a few miles north of Paris. An organization of French aerospace companies, GIFAS (Groupement des Industries Françaises Aeronautiques et Spatiales) sponsors and operates the event.

The first "Air Locomotion Show" opened in Paris at the Grand Palais on September 25, 1909, with 380 exhibitors. In 1953 it moved to Le Bourget to stay. The show began as an exposition of flying machines, including balloons and paraphernalia, with the aim of exciting public interest. With time, it began to cater to the specialized development of military aircraft and airliners, and more recently, smaller business airplanes, weaponry, and spacecraft. Its primary purpose is to benefit the French aerospace industry and the French economy.

Today, the site at Le Bourget combines a covered exhibit hall totaling 845,000 square feet and 430 reception chalets. Each company exhibits its products or services at rented booths, or "stands," as they are called in Eu-


*Ordnance and weapons like this Chinese surface-to-air missile (left) may be daunting, but a chalet's defenses command real respect. A receptionist at full charge (right) homes in on the photographer.*


rope; we pay a fee to GIFAS based on the floor area of our exhibit. Chalets are fewer in number and more expensive, but that's where the bulk of business gets done. Catering firms provide food and drink, and the atmosphere of hospitality warms both host and guest. The chalets are strategically placed to afford an excellent view of each afternoon's flying display. The flying is the most visible but hardly the most important activity at Paris.

The site at Le Bourget is enormous, and a marketing representative can walk 20 miles in a single day of rushing between appointments. All five members of our team were taxed to the limit with meeting customers, gathering information about competitors, and tending to housekeeping chores such as picking up credentials, making catering arrangements, and the like.

*Paris '87: half a million visitors, 10,000 cars, 3,000 phones, 1,465 exhibitors, and more than 200 airplanes. Forecast for '89: more of each.*

Some business is accomplished at the stand, but it is generally of a more technical nature—a customer who requires an explanation of how something works can see the product firsthand. And many prospects stop there first to introduce themselves and leave cards. Stand duty is tiring and

*Hours before opening time, the caterers and cleaning crew prep a chalet for its day's work.*

*Exhibit stands display wares and double as screening centers where introductions are made and cards exchanged.*

often dull, so we rotate it among the staff. For a 10-day show, three people are simply not enough.

ITEM: 120 francs for S. Harrigan, shoes reheeled

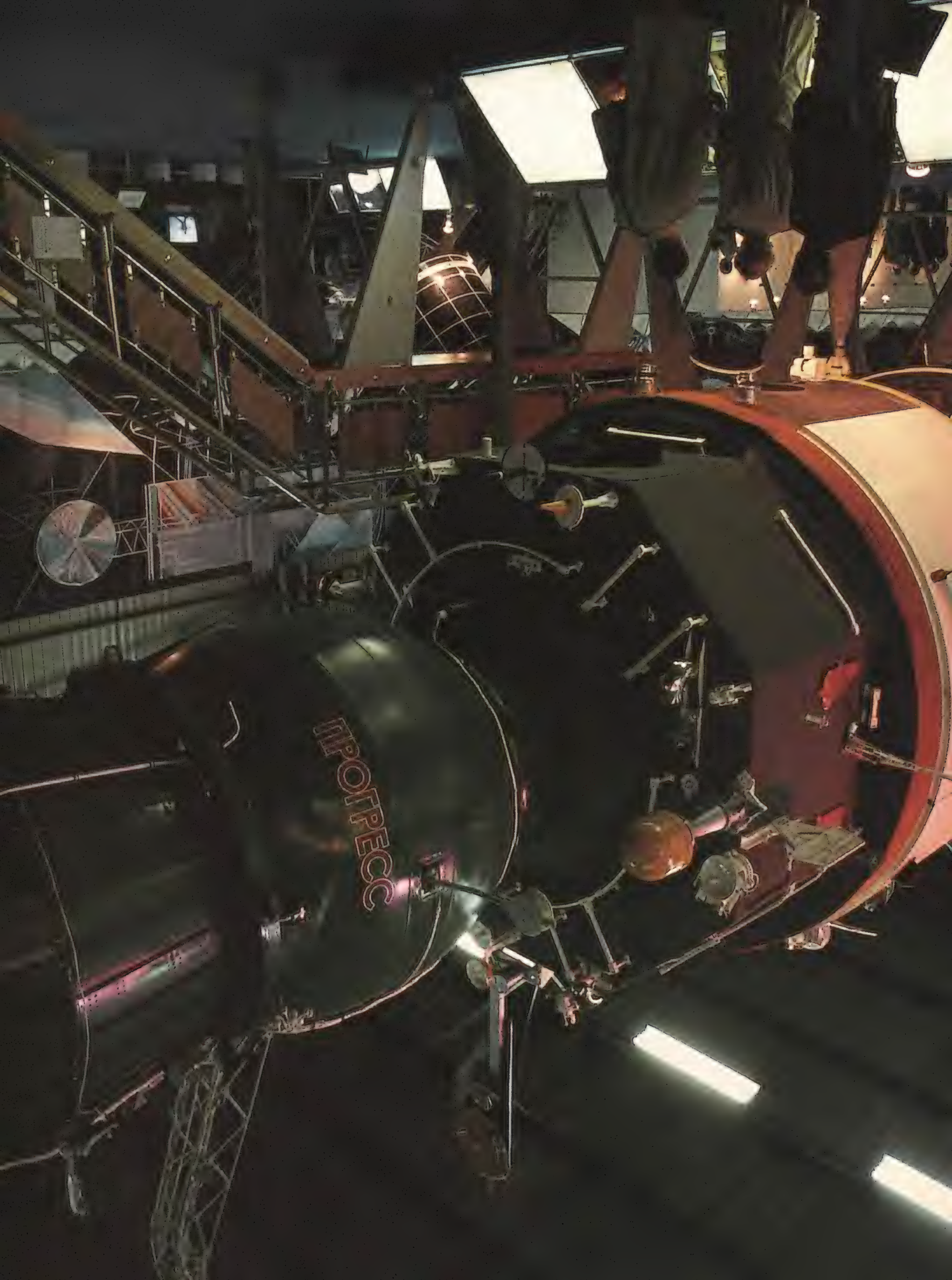
Harrigan was at the stand on Friday. Delayed by conversation with a prospect, she was late for an appointment at a reception chalet more than half a mile away. With no time to find transportation—almost impossible in any case (many people use bicycles)—she took off along the graveled paths in some haste, breaking the heel of one shoe. She had the shoes reheeled at one of the few repair shops open on a Saturday morning in Paris. There was a surcharge, of course.

ITEM: 360 francs for taxi from airshow to downtown Paris and return, B. W. Ellis

This was Ellis' first tradeshow for the company. On Monday, Marketing sent him to visit another firm, and Ellis arrived at their chalet unannounced and without an appointment. Security guards barred his entry, but using his limited French, he talked his way into the reception area.

Approaching the reception desks at Le Bourget chalets is like dealing with

*Governments selling to other governments bring their best and brightest. Here, officials view the Soviets' Progress.*


ПРОГРЕСС

the airline counter when your flight is canceled: the people behind the desk hold all the cards. Unless you are on their list of invited guests, their job is to keep you out. At Reception, the people screening visitors turned Ellis away—no invitation, no appointment, no admittance. Because of all the VIPs present, security was tight at the chalets, and GIFAS and national security forces conducted body and baggage scans at entrances, checked cars inside and out, and kept a close watch over the entire show.

Ellis finally persuaded the ladies at the reception area to find the executive he needed to see. He met with this man, who later invited Ellis to their factory after the show to make a


*Space hardware like this European Hermes shuttle now rivals aircraft in visibility.*

*The French are here to parade that which is French—or half-French—including some Alpha Jets and a Concorde.*

*On the "public" days, the gates swing wide and anyone can sidle up to an F-16.*

presentation on our behalf. In order to further exploit this opening and establish himself with that firm, Ellis hired a cab into town to buy a corsage and bottle of champagne for each of the reception persons. We in Marketing see this as evidence of an unusual degree of savvy on Ellis' part.

ITEM: 450 francs, flowers and champagne, B. W. Ellis

See preceding item.

ITEM: 850 francs, replacement of eyeglass frames, K.Y. Benson

Benson and Harrigan were returning to Paris on the Metro during afternoon rush hour when Benson's spectacles were knocked to the floor in the crush at the Concorde Metro stop. The frames were broken but the lenses were intact. Benson planned to meet with our state's congressional delegation that evening at the Ambassador's reception. She found an optometrist to replace the frames on the spot, paying the 100 percent premium he demanded. Benson made her reception, and both members of Congress agreed to a meeting at our stand the following day.

ITEM: 380 francs for suitcase, B. W. Ellis; 950 francs, overweight baggage charge

Ellis was designated custodian of documentary materials obtained at the show. All team members delivered brochures, news releases, and data sheets directly to him. (These are later analyzed and filed for reference.) Ellis went through the stack of documents and discarded duplicates, yet by the show's end he had still amassed more than 120 pounds of paper. He bought a suitcase to carry half this load and placed the remainder in his own luggage. At check-in, his three bags weighed 170 pounds. The overweight charge is regrettable but unavoidable.

Note: Suitcase in question is currently in storage in Marketing for official use by any employee, along with useful equipment received from other host companies: umbrellas from Teledyne, windbreakers from General Electric, a carry-all bag from Garrett, a document case from Aerospatiale.

SUMMARY: While we agree with the observation that no actual sales were recorded at the show, few companies make sales there. (One comment heard frequently was "The only people making money here are the caterers.") Deals are announced, but most have been concluded earlier. However, Paris offers an opportunity to meet customers and do business. The cost to attend may be high, but the cost of absence is higher. Should you have any further questions, kindly direct them to me.

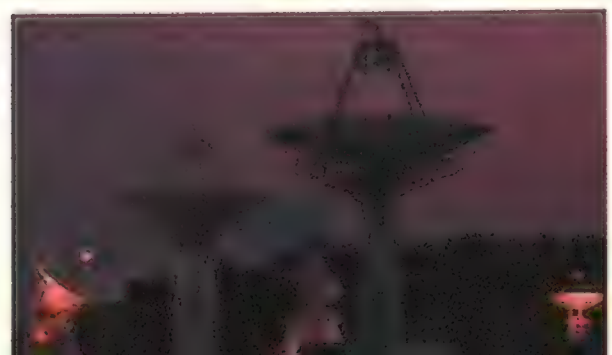
V. Max
Assistant Vice President
Marketing

*Kindly uniformed authority figures*—commissionaires—*oversee access to British hospitality.*

GÉRALD BUTHAUD/WOODFIN CAMP

*What's hot: the Rafale, France's candidate for a new Euro-fighter. What's not: a backdrop of old transports.*

# SPACE ISLAND



Nobody's keeping score, but the little-known Wallops Flight Facility may be America's most productive spaceport.

by Berl Brechner

*Photographs by Medford Taylor*

One night in December 1987 some residents of Washington, D.C., were surprised to see the glare from a rocket's engine arcing high over the eastern horizon of their city. They might have been even more surprised to learn that the rocket had been launched practically in their backyard.

The Black Brant X, carrying a $2.5 million experiment for the Strategic Defense Initiative Organization, had blasted off from America's least known launch site: Wallops Island. Despite its proximity to the nation's capital (150 miles) and the rest of the Eastern seaboard, this island spaceport is seldom in the public eye. Located on a Virginia island off a peninsula between the Atlantic Ocean and the Chesapeake Bay, Wallops launches dozens of little rockets each year that deliver big payoffs.

Wallops serves as NASA's own little skunkworks. Its breadth of involvement in space—involvement not accompanied by the spectacle or drama of other launch sites—keeps Wallops' agenda unpredictable. In the last three decades, over 14,000 rockets and missiles have been lofted from its five launch facilities. Some rockets travel as deep as 700 miles into space—three times farther out than the space shuttle ventures.

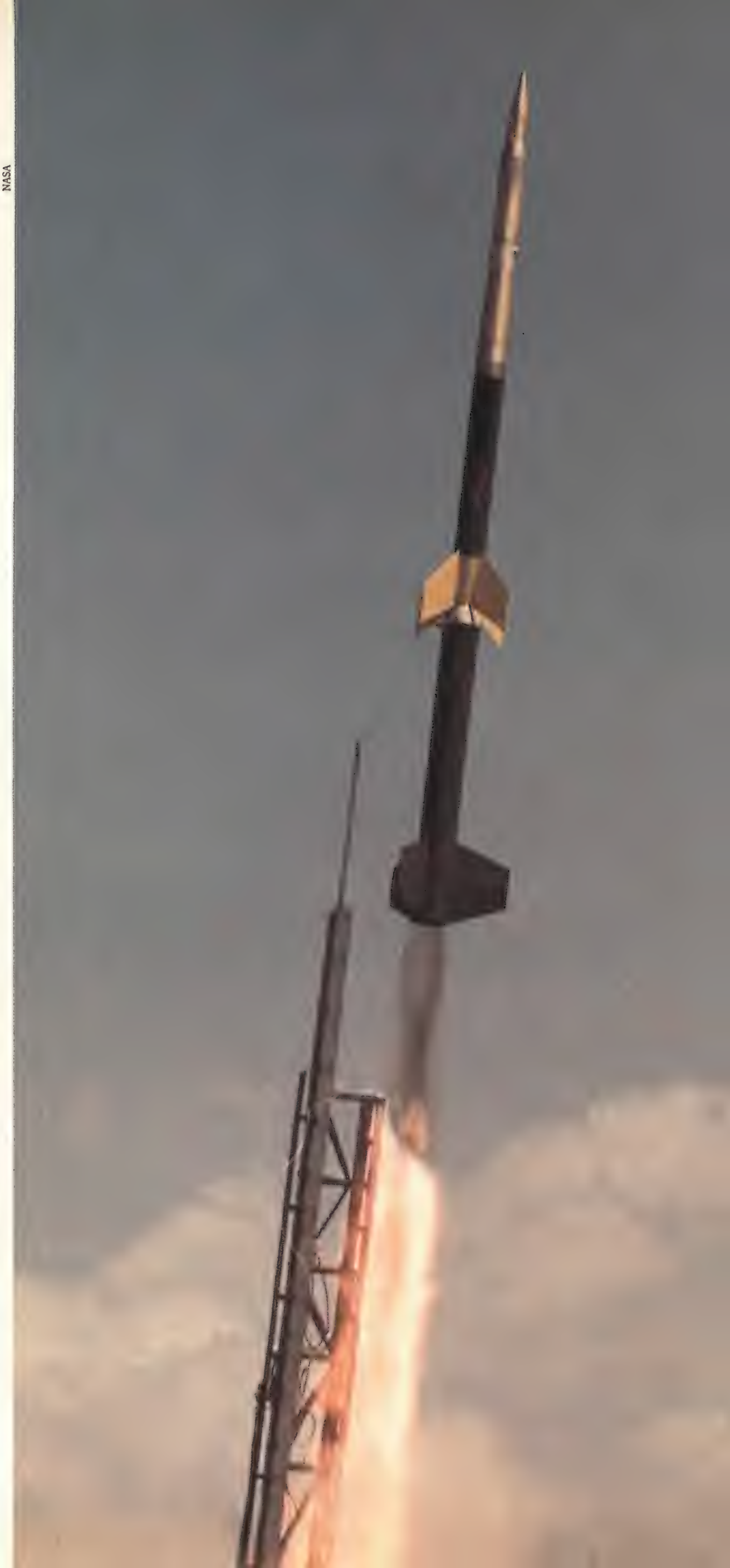
Named for John Wallop, a 17th century surveyor, the five-and-a-half-mile-long barrier island is not unlike hundreds of other narrow islands that hug the Atlantic coast from New Jersey to Florida. The nearest sizeable town, located on an adjacent island, is Chincoteague, a fishing village fast coming to terms with real estate developers. Not far away, on Assateague Island, wild ponies graze. Every year locals round up some of the ponies and drive them across a narrow channel, where they swim to Chincoteague. The ponies are sold at a now-famous auction that benefits the volunteer fire department.

Wallops Island got its first rocket pad in 1945, when NASA's predecessor, the

*Overleaf: Postcard sunsets are part of Wallops' scenery; telemetry antennas provide a technological contrast.*

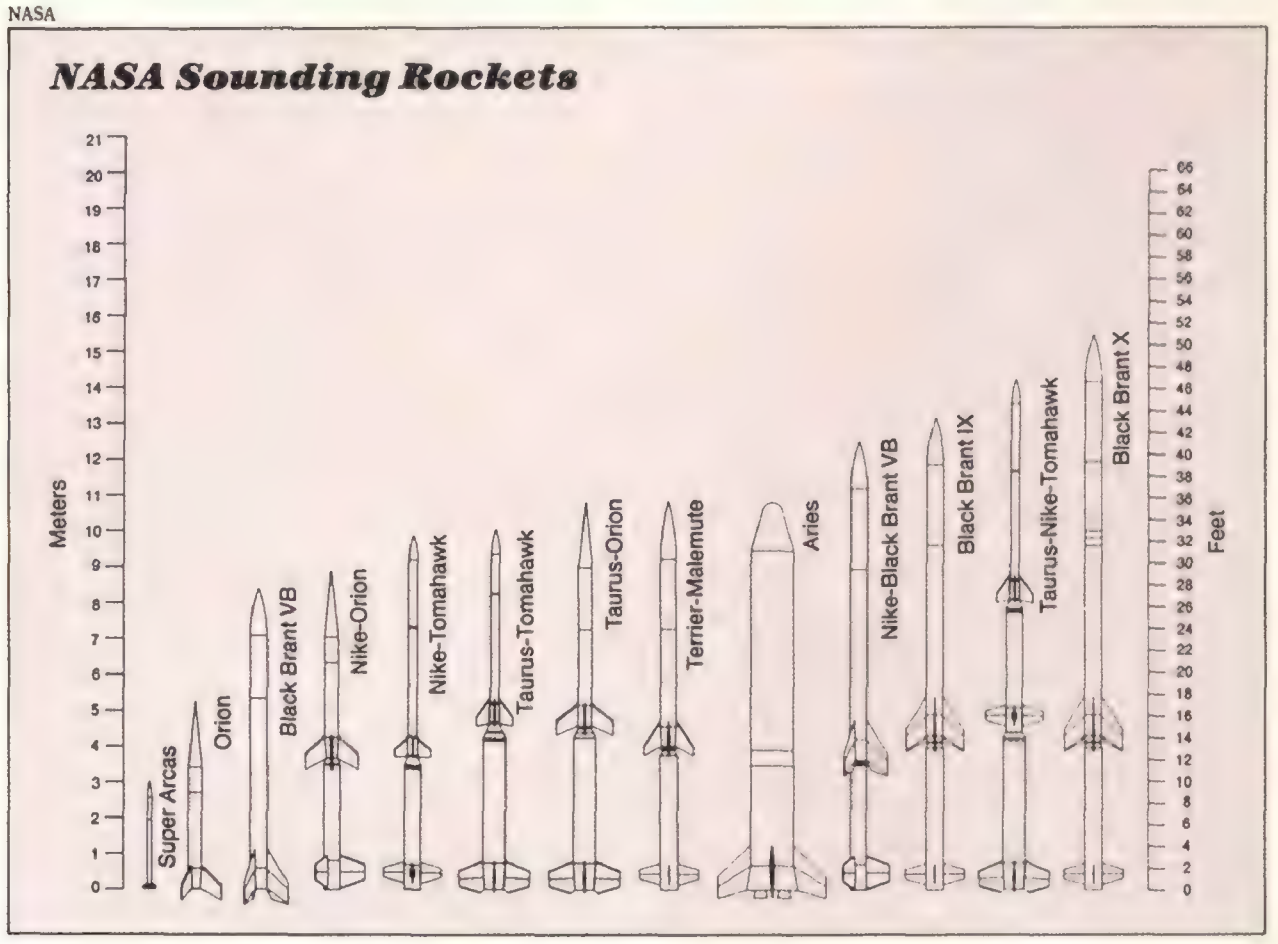
*The Nike-Orion sounding rocket is a Wallops mainstay. This one carried an experiment for the Air Force.*




NASA

*NASA's sounding rocket program includes 13 types of launch vehicles (right). Project specialists like Debra Frostrom (top) monitor missions; projects division chief Larry Early discusses payload event sequences with engineer Steve Skees.*

NASA




growing NASA. Now the main base for the Wallops Flight Facility, the former air station looks more like a college campus. Its 1,833 acres include the range control center, research airport, engineering and administrative offices, and main telemetry receiving station, as well as shops where machinists fabricate payload structures out of two-inch-thick aluminum and technicians lace miles of circuits to make the wiring harnesses that are a rocket's veins and arteries.

Wallops technicians bask in their inconspicuousness among the sand dunes and eel grass, an isolation that tends to breed a non-NASA style. With both Chincoteague and Assateague a stone's throw away, it's unlikely that Wallops will ever loft the larger launch vehicles used at Cape Canaveral or the Air Force's Vandenberg facility in California. In any event, the folks at Wallops would probably get impatient with the mountain of paperwork and the snail's pace that come with projects such as the space shuttle.

"The key is that we're not working with man on board," says Larry J. Early, who is the chief of the projects division. "Our documentation for a launch is like this," he says, closing his thumb and forefinger to within a half-inch. "There is a risk of failure with each mission.

National Advisory Committee for Aeronautics in Langley, Virginia, decided it needed a remote site for military tests. In 1950 the government acquired the whole island and another thousand marshy acres across from it for $93,238.71. When Bob Duffy, now Wallops' chief of operations, started working at what was then the Pilotless Aircraft Research Station on the island in 1952, "there were 75 of us," he recalls, "five engineers and 70 others. We rode the boat out to the island, so you knew everybody and everything about them, from riding on the boat, back and forth." In 1960 a causeway and bridge were built connecting the island to the mainland and its poultry farms and fields of potatoes, beans, and cucumbers.

Today the Wallops Flight Facility, part of NASA's Goddard Space Flight Center in Greenbelt, Maryland, and the only launch range completely controlled by the agency, employs almost 1,000 and also includes the old Chincoteague Naval Air Station, eight miles inland. The air station was phased out in 1959, and its buildings, runways, and bunkers were turned over to the new and rapidly

*As a crash truck waits near the runway, an ER-2 takes off on a remote sensing mission for NASA.*

*Fishermen from Chincoteague unload sea trout, bluefish, and the rest of the day's catch.*

And we accept those failures. To minimize the chance of failure through extensive testing and evaluation would take a lot of money. Instead of flying fail-safe, we fly more missions."

The Wallops technicians welcome the variety of experiments and relish their closeness both to the projects and to the scientists who run them. "You see the project here from end to end," says James W. Gray, chief of engineering. "A project runs anywhere from one to three years, and you follow it from concept right through to completion."

The first technicians at Wallops were concerned with developing ways to knock down *kamikaze* flights with air-to-air missiles. In the late 1940s and early 1950s they fired airfoils and instruments through the atmosphere at supersonic speeds to pave the way for the breaking of the sound barrier. A year and a half before Cape Canaveral and Alan Shepard became household words, monkeys flew suborbital jaunts strapped into prototype Mercury capsules launched from Wallops.

For more than a decade now, the heart of Wallops has been NASA's sounding rocket program, which launches 13 rocket configurations on suborbital flights. The program began in 1970 with a handful of outdated 14-inch-diameter Hawk ground-to-air missiles. "They were a relic for the Army, but for us they were great," says L. Warren Gurkin, head of the sounding rocket branch. The Hawk missiles (renamed Orion by NASA) are still in use, along with other surplus military rockets—Nike, Taurus, and Terrier. "We take bullets and make them into plowshares," says Gurkin. A two-stage Nike-Orion launch vehicle costs NASA about $15,000.

The Canadian-built Black Brant X sounding rocket is a three-stage configuration nearly 60 feet long that can lift a 200-pound payload to an altitude of 700 miles. But by far the most complex launch vehicle in Gurkin's arsenal is the Aries, in its earlier life the second stage of a Minuteman I missile. Unlike the other sounding rockets, the Aries is guided by elaborate navigation gear and has gimbaled nozzles for directional control. The Aries can loft a payload weighing over a ton to a height of nearly 150 miles.

Each year NASA's sounding rocket program launches 40 to 45 experimental packages on suborbital flights into space or the upper reaches of the atmosphere from around the world. Six to eight are launched from Wallops. "To relate the scientific significance of what we do at Wallops to the man on the street is very difficult," says Larry Early. He describes the eclectic assortment of sounding rocket experiments at Wallops as "good, solid science." It includes studies of cosmic rays, solar phenomena, pure astronomy, and plasma physics—"what happens when all the garbage from the sun hits the stuff that


*The Aegis facility works with the Navy's most advanced vessels; local fishermen stick with trawlers.*

surrounds the Earth," as one Wallops veteran puts it.

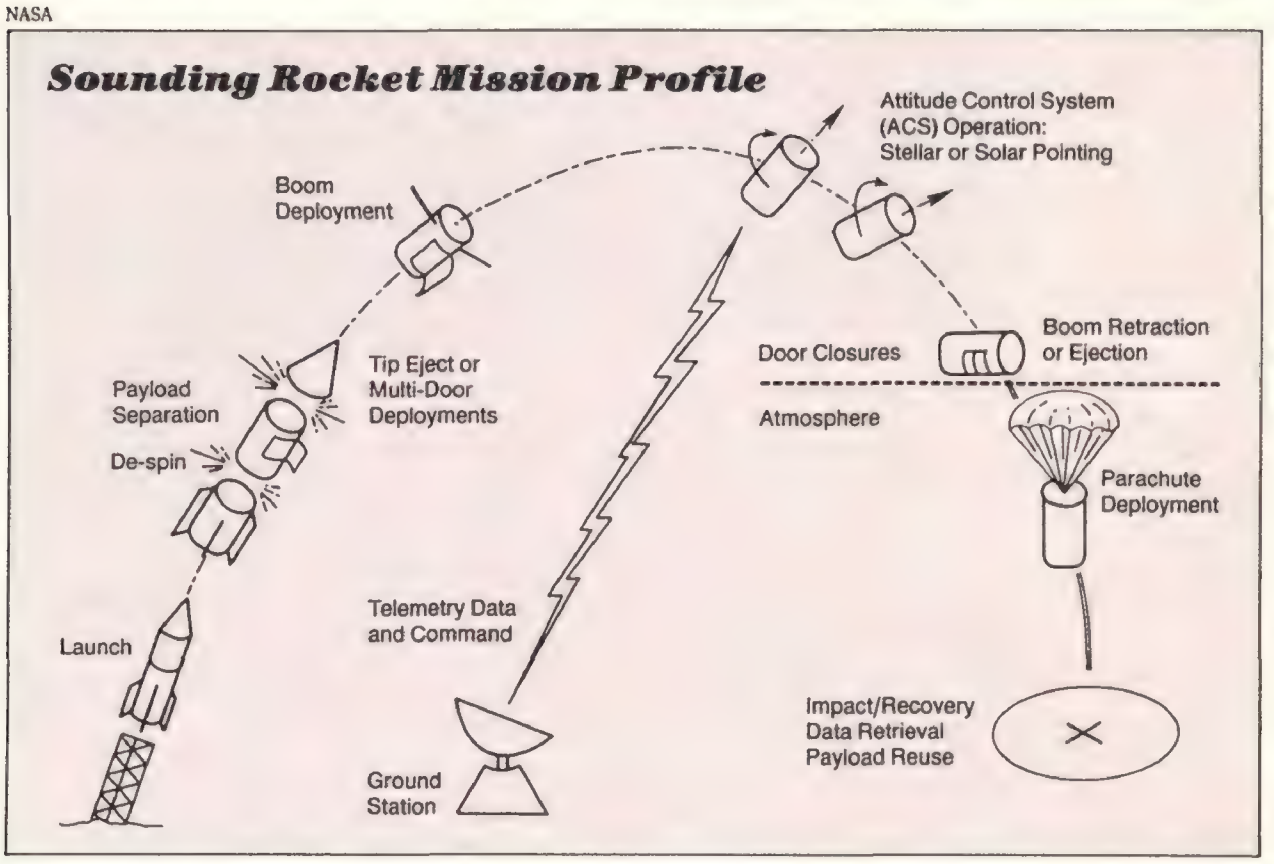
Although about 15 percent of the work at Wallops comes from the defense department, most of the scientific experiments aboard the sounding rockets come from universities. An experiment usually begins when a professor and his or her students apply to NASA for launch support of a study. If the launch is approved, Larry Early and his staff work with the experimenters to determine the rocket and launch configuration, package the payload, create the necessary electronics, and manage the launch and the gathering of data.

Flying time for the experiments is about five to 15 minutes. That means that payload scientists have little time for swinging a telescope toward some object in space, or for releasing and observing a gas cloud, or for collecting data. A heatshield protects the experiment package as it falls back through the atmosphere and drops by parachute toward the Atlantic. A NASA-operated airplane snags the payload from the sky before it hits the sea and returns it for evaluation or reuse. Data telemetrically transmitted during the experiment's few minutes of glory may take the scientists a year to evaluate.

BERL BRECHNER

*Now one of five launch areas, the original site fired its first rocket in 1945.*

NASA




*Technicians prepare an Orion for launch. Its mission profile could be much like the one at left.*

The sounding rocket program has a good track record. Even without the exhaustive quality assurance evaluation that characterizes manned space flight, Wallops maintains an enviable level of success for its missions. Its solid-fuel rockets have a 98 percent reliability rate. Overall mission success—rockets and payloads—is slightly lower, around 91 percent in the last five years.

Ask any Wallops technician about the experiments and you will hear the voice of a proud parent. A recent experiment validated the work of Nobel Prize winner Hannes Alfven. Wallops rockets carried payloads designed by teams from the University of California at San Diego, the University of Alabama at Huntsville, and several other institutions. At altitudes as high as 267 miles, the payloads released barium and strontium, which created clouds visible up and down the East Coast. The cloud patterns and flow confirmed earlier lab work that had tested Alfven's theory on the solar system's formation.

Wallops also provides training facilities for the Navy. Vandal rockets fired out over the ocean 50 feet above the water at Mach 2 give Navy crews a chance to practice identifying, tracking, and destroying low-altitude targets. The Navy recently built a training center at Wallops for its Aegis fleet operation and battle system. Its proximity to the Naval base at Norfolk, Virginia, allows the training center, which looks like the superstructure of a beached destroyer, to work directly with the ships of the Atlantic Fleet. Wallops' secluded beachfront also allows the use of powerful radars at ground level without the risk of zapping civilians with overdoses of microwaves.

Wallops technicians have acquired something of a "have rocket, will

travel" reputation in the space business. Last year, when supernova 1987A flared in the heavens (see "Blast From the Past," August/September 1988), they played a role in one of the biggest astronomical finds in history. Because the supernova could be seen only in the southern hemisphere, Wallops technicians prepared a launch site at Woomera, Australia. Rocket launchers, telemetry equipment, and radar vans were shipped from the Virginia base; six Black Brants sent various X-ray and ultraviolet sensors into space to study the supernova.

It was the kind of quick-response mission, says Early, that makes Wallops unique. Other rockets, which rely on people, equipment, fabrication, and planning from Wallops, blast off from Peru, Norway, and a score of other remote sites around the world.

Wallops' future should hold more satellites. Twenty-one have already been launched into orbit from there. The most recent launch, three years ago, lofted two Air Force satellites intended as targets for anti-satellite weapons.

*In the marsh grass at nearby Assateague National Seashore, cattle egrets cross paths with wild ponies.*

(The satellites, called Instrumented Test Vehicle spacecraft, are still orbiting today—a result of international diplomacy that put anti-satellite weapon development on hold.) But the federal government is soon expected to give the green light for commercial satellite launches at Wallops, and the first may be made within the next five years.

Some industry analysts predict a boom in commercial launches from the tidewater island. Compared with Kennedy Space Center in Florida, Wallops' smaller scale of operations is ideal for private firms. Warren Keller, who directs Goddard's suborbital projects and operations and is based at Wallops, foresees small commercial satellite launches for, among others, the "microgravity community"—those who want to grow crystals, balance motors, and do other work that's more effectively accomplished in the near-weightlessness of space. Six firms have already expressed interest in the launch site, and NASA has given the LTV Corporation an initial go-ahead to supply commercial launch services for Wallops.

The Virginia space base expects to celebrate its 45th birthday next year with a return to its roots—the testing of aeronautic concepts. Proposed Project HYFIRE (Hypersonic Flight and Instrumentation Research Experiment) will do hypersonic research. Wallops will launch three- or four-stage rockets that will carry airfoils and other components up to altitudes around 300,000 feet at speeds of Mach 8 to 25.

"Everything we're doing is steady or increasing," says Keller. Since Wallops came under the wing of the Goddard Space Flight Center in 1981, its research and development budget has more than tripled to $74 million, and its operating budget is up from $40 million to $100 million. NASA and contractor employment has risen from 730 people to its current 1,000. "If having a lot of work means rosy," Keller says, "then the outlook's rosy for Wallops."

# The Smithsonian Traveler

THE LATEST WORD ON TOURS, EXPEDITIONS AND LEARNING ADVENTURES



## Domestic Study Tours

**Spring Gardens** April 30-May 7: From Washington, D.C. to Wilmington, Delaware.

**Brooklyn With a Bang** May 25-28 or September 14-17: Architecture, art.

**Sanibel-Captiva** May 28-June 3: Flora and fauna on Florida's Gulf Coast.

**Alaska Landscapes** June 20-July 2 or July 25-August 6: Denali National Park and more.

**Family Sampler** June 30-July 9: Affordable weekend of Smithsonian fun for all ages.

**Grand Canyon** July 1-10: Raft down the magnificent Colorado.

**Pueblo Indians** July 9-16: Based in Sante Fe. Southwestern arts and culture.

**California: Big Sur to Yosemite** July 13-22 and September 13-22: Easy scenic hiking.

**Salmon River** July 18-26: A raft trip that combines camping and a lodge visit.

**Sojourn in Santa Fe** July 23-30: Study historic and contemporary Hispanic culture.

**Waterton-Glacier** July 24-August 4: Hike the back country of Montana and Canada.

**Lewis & Clark** July 29-August 5: Horseback and camping on Idaho portion of 1805 trail.

**Colorado Rockies** August 5-11: Enjoy outdoor program at the Nature Place.

**Aviation Weekend** August 8-13: Abbotsford Airshow, Boeing, Seattle flight museum.

**Railroading the Rockies** August 11-19: By private car and narrow-gauge steam train.

**Alaska Cruise** August 11-22: Explore the Inside Passage aboard an expedition ship.

**Pacific Northwest** August 15-26: Seattle, Vancouver, Victoria, San Juan Islands.

**Black Hills & Crow Fair** August 16-25: Includes Yellowstone and the Tetons.

**Romance of the Gold Rush** September 2-9: From Sacramento to San Francisco sail aboard tall ship *California.*

**Detroit Auto Barons** September 14-17: Visit estates of Ford, Fisher and Dodge.

**Columbia River Cruise** September 21-30: Sail from Victoria through Puget Sound to Portland and up Columbia to Snake River.

## Foreign Study Tours

**People's Republic of China:** Ten tours in 1989 for new and repeat travelers.

**European Countryside Programs** May-September: Relaxing sojourns in Hungary, England, Austria, France, Italy, Switzerland, West Germany or Wales.

**Botswana-Zimbabwe** May 9-26: Includes Victoria Falls and Okavango Delta.

**USSR-Golden Ring** May 20-June 3 or September 9-23: Study ancient Russian culture.

**Danube Voyage** May 23-June 9: Art and history from Romania to West Germany.

**Central Asia** May 26-June 9 or September 15-29: From Leningrad, fly to Samarkand and Bukhara. Ends in Moscow.

**Florence Seminar** May 27-June 11: Classes and excursions based in a villa-hotel.

**Greece** May 28-June 12: History and art from Thessaloniki to Athens.

**Odyssey of Flight** June 2-13: Paris Airshow and 45th anniversary of D-Day.

**Highlands of Scotland** June 2-18: Culture and natural history. Reside at Aigas Field Centre.

**Turkey's Eastern Reaches** June 7-24: East from Ankara to the ancient Orient.

**Cotswold Walks** June 8-20: A variety of walks through the English countryside.

**Poland** June 9-25: History and culture in Warsaw, Kraków and other cities.

**Gardens of Brittany and Normandy** June 10-23: Includes private gardens. Ends in Paris.

**British Isles Voyage** June 16-July 3: Visit remote hamlets and islands aboard the *Argonaut.*

**Cave Art in France and Spain** June 19-July 4: Cantabric Coast, the Pyrenees, Dordogne.

**Swiss Countryside Walks** June 21-July 6: Moderate or challenging day hikes.

**Walks in England's Lake District** June 29-July 12: Natural and cultural history.

**Scotland by Train** July 1-14: Skye, Glasgow, Edinburgh, Inverness, the Highlands.

**England for Families** July 10-20: Storybook London and the Cotswolds for families with children and grandchildren (ages 7-14).

**Iceland** July 22-August 6: Circle the island, study natural history, geology.

**Baltic Passage** July 28-August 15: Cruise to Denmark, Sweden, Finland, Leningrad.

**Lena River-USSR** July 28-August 16: Exclusive cruise through Siberia.

**Voyage to Sumatra and Java** August 1-17: Visit Singapore, Jakarta, Borobudur.

**Trinity Seminar** August 11-26: Study rare books, ancient manuscripts in Dublin.

**Voyage to Greenland and Hudson Bay** August 19-September 4: Natural history, Inuit culture.

**Canadian Rockies** September 6-17 or 19-30: Glacial mountains, canyons, hot springs and great resort beckon hikers to Banff, Jasper and Lake Louise.

## Seminars and Research Expeditions

**Air and Space Archival Treasures** Washington, DC July 23-August 4: Contribute your time, talent and financial resources to Smithsonian's research as you help archive historic documents and films at the National Air and Space Museum and the Paul E. Garber Facility.

**Aircraft Restoration** Oshkosh, Wisconsin September 21-24: Learn techniques of aircraft restoration during hands-on workshops led by specialists from the Paul E. Garber Facility and EAA Museum.

**Write to Smithsonian National Associates Program, Washington, DC 20560 or call (202) 357-4700 for tour brochures, (202) 357-1350 for seminar and expedition brochures.**

# *Picturing Kenya*

From a single-engine airplane, photographer Baron Wolman is revealing some of Africa's lovelier sights—and a few of its grimmer prospects.

by Elaine de Man

PHOTOGRAPHS BY BARON WOLMAN

*When Wolman's airplane touched down at Fig Tree Tented Camp, Maasai herdsmen nearby decided to investigate.*

*The home of Danish writer and plantation owner Karen Blixen is a grand example of the colonial influence on Kenya in the early 1900s. The house is located in a posh suburb now called Karen.*

Somewhere on the slopes of Mount Kenya there is a gray wool cap that has the word "Photographer" knitted on its side. One day last May it came floating down out of the sky, through the clouds and the tops of the trees, to rest on the forest floor. A giraffe, browsing in the woods, might have seen it fall. A rhinoceros may have snatched it up with his horn. An African villager might now be walking around with it on his head.

The hat originally belonged to Baron Wolman, a photographer from California. He was circling Mount Kenya in a Cessna 182 with his head out the window when the cap blew off. "I've never lost anything out of an airplane before," he said at the time. "I hope this isn't a bad sign."

Wolman, 51, was working on a book of aerial photographs that will be called *Kenya Air Safari.* It may seem an unlikely undertaking for someone who'd worked as a rock and roll photographer for *Rolling Stone* and later helped start a fashion magazine called *Rags.* But Wolman had always wanted to fly, and in 1976 he and a friend bought a used Cessna 150 and started taking lessons. As he sees it, it was only natural to try his hand at aerial photography. His interest grew into a specialty: in the past eight years he has published books of aerial photographs of California and Israel, and he recently photographed the U.S.-Mexican border from the air ("Holding the Line," December 1988/January 1989).

Those were places he felt emotionally committed to, and places he knew had strong photogenic potential. Kenya, on the other hand, was an unknown commodity. He had been encouraged to take on the project by a

ELAINE DE MAN

*On the verandah of Karen Blixen's home, the photographer ponders the amusement potential of traditional ground-bound tourism.*

*Flamingos are drawn to the huge algae bloom in the Great Rift Valley's Lake Nakuru. The flamingos travel up and down the valley, stopping at any lake that looks promising as a food source.*

local businessman who owned part interest in a ballooning operation in the Masai Mara, a Kenyan game preserve. Before leaving California, Wolman went through some guidebooks and carefully compiled an alphabetized list of sights that sounded promising. Nonetheless, when he arrived he had his doubts. Would the project cost too much money? Renting an airplane was going to be expensive, about $118 an hour. Would he be able to find enough great photographs to make a book? Would he get bitten by a mosquito and die of malaria?

What, he wondered as he brushed his teeth with French bottled water, was he doing in Africa?

During the late 1800s, when Europe was carving the rest of the world into chunks, Kenya and Uganda fell into Great Britain's "sphere of influence." Because land-locked Uganda was of strategic importance to the British, they built a 580-mile railroad from the port city of Mombasa, on the east coast of Africa, across Kenya to the shores of Lake Victoria. The railroad was completed, at great expense, in 1901. The problem was that it had nothing to haul. In order to justify the expense of the system (which was being called the "Lunatic Express" by its opponents back in England and the "Iron Rhinoceros" by puzzled Africans), white settlers were induced to emigrate from Europe and grow cash crops that could be transported on the train. Britain formalized its domination in 1920, when it made Kenya a colony.

Kenya won its independence in 1963, but there are still abundant reminders of colonial rule. The Iron Rhinoceros still chugs across the country. The Ngong Road Racecourse still has horse races on Sunday afternoons, just over the hill from the old house of Baroness Karen Blixen (better known as Isak Dinesen, the author of *Out of Africa*). And tea, coffee, pineapple, and sisal plantations, established by the European settlers at the turn of the

*An aerial photograph can reveal social complexities sometimes missed on the ground. This one shows the overcrowding of a poorer area of Nairobi, but it also shows that the houses have metal roofs—a Kenyan status symbol.*

century, still constitute the basis of the national economy.

Tourists, however, are more familiar with the splendid coast and clear turquoise waters of the Indian Ocean, the Maasai standing watch over their herds of cattle, the game parks and wildlife preserves of the interior, and the lakes festooned with flamingos. Geologists and anthropologists are drawn to the Great Rift Valley, a crack in the African geological plate that runs the length of Kenya. Up in the north, on Lake Turkana, Richard Leakey continues to discover fossils that suggest that Africa is indeed the "cradle of mankind."

They are all part of the story of Kenya. It is a story that Wolman wanted to tell from the air, where he could capture the vast contrasts in cultures and resources, the enormous economic and geological forces that define life in Kenya today and will affect it in the future.

"That's it sneaking through the canyon," shouted Will Wood, Wolman's pilot, over the drone of the airplane's engine. "It's the passenger train."

It was 6:15 p.m., and the sun was low on the horizon, casting a warm glow over everything and creating shadows that gave the scene definition. The train, unfortunately, was in the shadow of a canyon. Mindful of the sun's descent, Wood and Wolman flew along the tracks ahead of the train until they found a railway station that still basked in the sun. Now they had only to circle and wait for the train to come chugging around the hill and toward the station. The picture would have all the elements Wolman wanted: the train, the original tracks of the Iron Rhinoceros, the people on the platform, the name of the station—Kikuyu—spelled out in white rocks so it could be read from the air, and the rich

*The Maasai use thornbush to fence in their encampments. Their lambs and calves stay inside the herdsmen's huts.*

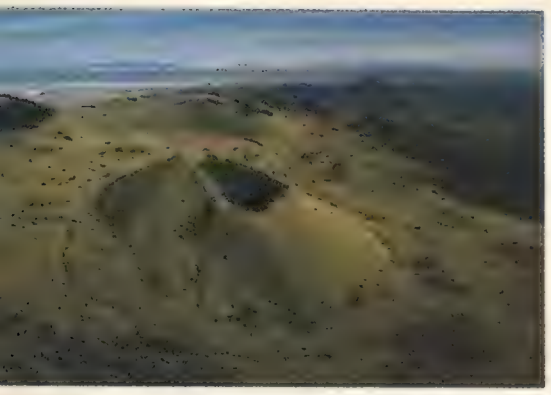
colors only available just after sunrise and just before sunset. At this time of day, the yellow and red train would appear to glow.

This had not been an easy shot to arrange. When Wolman set out to get a picture of a train approaching a station, he was quickly stymied. The main station, located in Nairobi, was out, since he couldn't get clearance to fly over the capital city. "You see," the senior tourist officer had said, "this is not a tourist book you are doing because it is on the whole country. This is classified as a cultural book. And for that, you will have to obtain permission from the office of the president." When Wolman called the office of the president, the person he needed to talk to was out. And no one would return his calls.

Wolman tried to find a schedule listing arrival and departure times for other stations, but his inquiries were met with bewilderment or blank stares. So he finally decided to simply follow a train after it left Nairobi and see if he could catch it approaching a station in the perfectly lit half-hour before sunset. This plan, however, had its own complications: on the one hand the train had to be far enough out of Nairobi to have cleared the forbidden airspace, and on the other hand it had to be photographed near enough to Nairobi's Wilson Airport to allow Wood and Wolman to make it back by 6:30 p.m., when all single-engine planes in Kenya must be on the ground.

"I've never been in a situation where we couldn't just shoot until dark and fly back by night," said Wolman. "It isn't a problem in the States because there are so many navigational aids. In Israel we were in positive radar control all the time," he adds, "so we were never lost. And most importantly, we had a radar code from the time we took off to the time we landed so they could help us if we got into trouble. It's exactly the opposite here. There's only a couple of main roads and only a few navaids to check our position on." And while there is no shortage of landing strips, there are only four places in all of Kenya—a country roughly the size of Texas—where you can get aviation fuel. These were problems Wolman hadn't anticipated.

Finding a suitable pilot, however, had been relatively easy. Kenya breeds bush pilots. Will Wood, 31, born in California and raised in



*The Chyulus may be some of the world's youngest mountains, having been formed within the last several hundred years.*

*Visitors to the Ark game lodge can watch all manner of wildlife gather at the nearby watering hole.*

*Kenya has only four refueling stations, so Wolman's pilot had to make frequent jerry can fill-ups (above).*

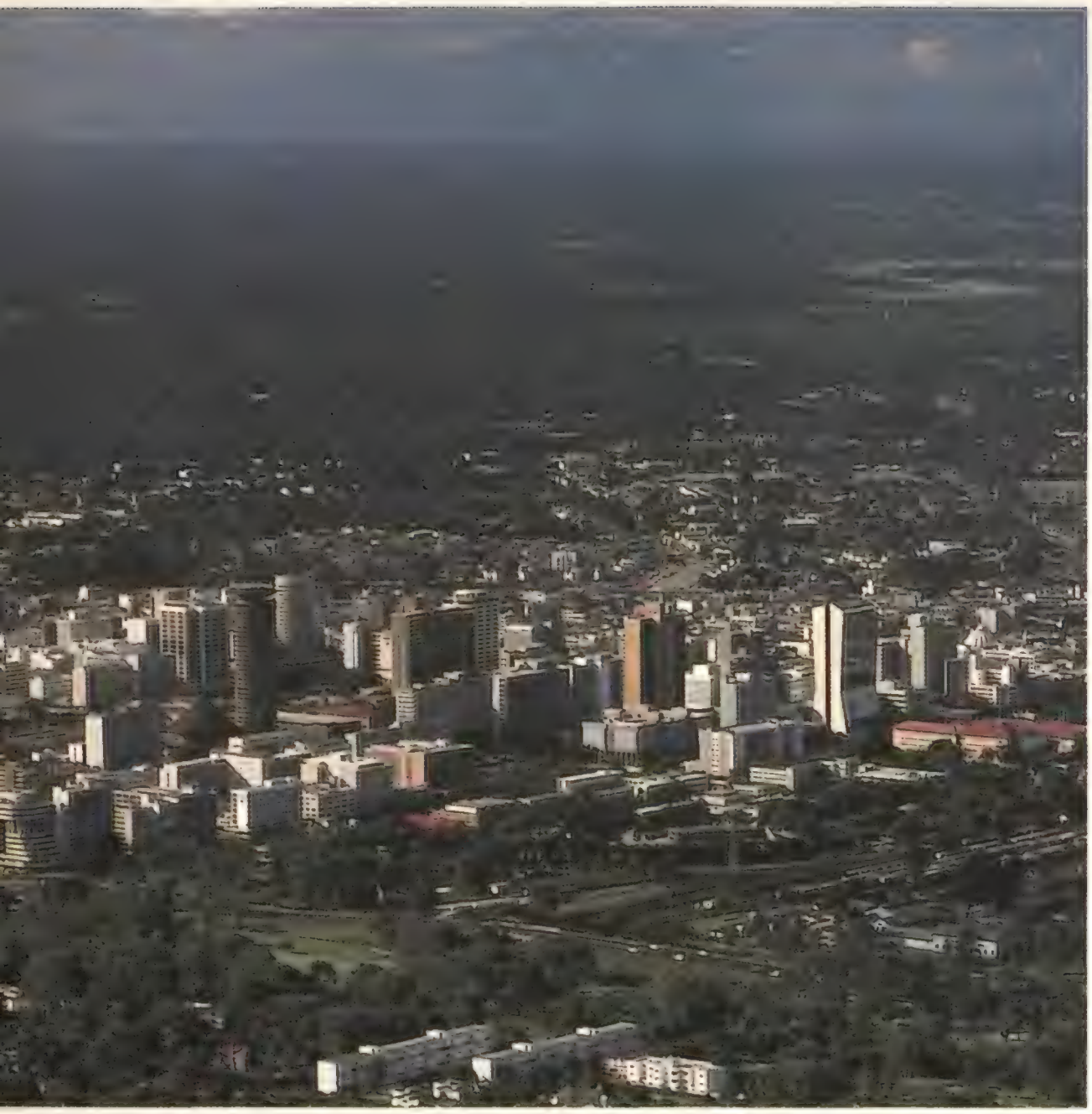
Kenya, is a pilot for the African Flying Doctor Service. Usually charged with flying doctors, nurses, and patients from point to point, he welcomed the opportunity to do a little sightseeing in his spare time.

From the air Wolman and Wood could just see the train rounding the bend on the last leg to Kikuyu Station. It looked like a model railroad, and the people standing on the platform looked like bright little dolls. Wood made one slow turn while Wolman checked his camera and opened the airplane window.

And then a giant shadow fell across the scene. The train lost its glow and the people on the station platform turned into flat little spots. The sun, still above the horizon, had dropped behind a low layer of clouds.

The day, fortunately, had not been lost. Far from it. At daybreak Wolman and Wood had taken off for Lake Magadi, the southernmost of the seven lakes that dot the Kenya Rift. They flew low over the lake while Wolman photographed the subtle play of color, the bubbling hot springs along the edge, and the flamingos in the shallows. They went on to Shombole, a town near Tanzania, where everyone came out of their houses to watch the little airplane circle overhead. They came across an *enkang,* a group of mud huts surrounded by a fence of thornbushes, where the resident Maasai herdsmen were leading their goats and cattle out to graze. And they photographed Wilson Airport, home base for most general aviation operations in Kenya, just before they landed. All before 9 a.m.

In the afternoon Wolman photographed the slums of Kibera, a rambling shantytown, and the estates of Karen, the posh suburb named after former resident Karen Blixen. He caught the Ngong Road Racecourse as Rasputin charged across the finish line to win the Aga Khan Jubilee Trophy. And he got pictures of Giraffe Manor, recently used in the making of the movie *White Mischief,* with the giraffes surrounding the circular Giraffe Center,



*As Kenya's population swells and its farming opportunities disappear, Nairobi's population is expected to triple or even quadruple by the end of the next decade.*

*Wolman finally managed to catch a train. These stately coaches travel daily from Mombasa to Nairobi.*

waiting to be fed by the tourists.

It wasn't a bad day at all. In fact, Wolman covered more ground in a day than most Kenyans will see in a lifetime.

"It certainly smells better from the air," Wolman recalled of his visit to a Maasai *enkang*. The smell was overwhelmingly of dung, which the herdsmen use in constructing their homes. The little huts were pitch black inside and filled with smoke. And the flies—the flies were so bold that they would light on the faces of the people.

Wolman made several ground-bound forays during his visit, but he found the realities of Kenyan life disturbing. He was clearly more comfortable working in a cockpit. "What I do keeps me from coming in contact with all that," Wolman said about the scene at the Maasai encampment. "I get in the plane and shoot it from a distance without having to deal with the experience."

But while his perch in the sky may have kept at bay some of the grittier realities of Kenyan life, it also exposed others. He saw an *enkang* that had been abandoned—a sign that aridity and the ever-encroaching tourist industry have forced the Maasai to look elsewhere for land. And he photographed a herd of elephants charging across the barren plains of Amboseli National Park while a herd of tourist-filled mini-vans charged toward it. It was a moment illustrating a lot of what is wrong in Kenya today. The economy needs tourists. The tourists want wildlife. The wildlife needs to roam about undisturbed. If the tourists disrupt the wildlife, how can Kenya continue to attract tourists? The dilemma is apparent in this single picture.

Some of Kenya's problems, however, are harder to spot. "It wasn't until I spoke with Richard Leakey that I began to understand the significance of a lot of the things I was seeing and photographing," Wolman says today. Leakey, the director of Kenya's National Museum, is the son of famed anthropologists Louis and Mary Leakey. An eloquent spokesman for his native Kenya, he will be writing the introduction to *Kenya Air Safari*. It was Leakey who pointed out to Wolman that in Kenya, a country dependent on agriculture, two-thirds of the land is semi-desert and unsuitable for farming. Most of the arable land has been divided up into large plantations, small land holdings, and tiny subsistence farms. The large plantations are the major sources of hard currency for the country. The subsistence farmers grow just enough to feed themselves. But Kenya has the fastest growing population on earth, so when the time comes for the farmers to divide their land up among their sons, their families will have to subsist on less, and the next generation, even less.

However complex the portrait that ultimately emerges, the book will still be beautiful—Wolman feels sure of that. His three-week scouting trip has proved successful; he came back with half of the pictures he'll need. One more trip ought to finish the job.

Meanwhile, Kenya waits. The grasslands of the Masai Mara undulate under an endless sky. Giraffes lope across the horizon and lions slink through the grass. The Maasai stand watch as their cattle graze on the grass landing strip next to Fig Tree Tented Camp. There a lone airplane once sat, covered with early morning dew. When Wolman and Wood climbed inside, they could see fingerprints and nose prints on the outside of the windshield. ✈

ROBERT McCALL, COURTESY PARAMOUNT PICTURES

# Planet of Origin: Hollywood

"Engineering, what do you make of that vessel?"

by Dennis Meredith

*The* Enterprise *may have been the pride of Starfleet, but today's engineers note some flaws in the vessel's design.*

Spaceships have been appearing in the movies since at least 1902, when French filmmaker Georges Méliès, in *Le Voyage Dans la Lune,* blasted his intrepid space travelers to the moon inside an artillery shell. Since that silent adaptation of the Jules Verne classic, hundreds of science fiction films have lured audiences with their strange creatures and alien worlds. For many writers and fans, though, the greatest fascination has been with the spaceships that transported the drama—marvelous machines that are frequently presented as the ultimate advances of the technology that we know and use today.

While some of the contraptions are plausible, some are not, according to a team of engineers at McDonnell Douglas Astronautics Company who are helping design part of the proposed U.S. space station. They analyzed three of the most famous cinematic spacecraft—the starship *Enterprise* from the *Star Trek* television show and films; Han Solo's *Star Wars* hot rod, the *Millennium Falcon*; and the *Discovery* from *2001: A Space Odyssey.* Of the armada of Hollywood spaceships, these look like machines that mean business.

And unlike such clearly alien craft as the extraterrestrial Mothership from the movie *Close Encounters of the Third Kind,* these vehicles were supposedly designed by Earthlings (or, in the case of the *Star Wars* universe, reasonable facsimiles).

"The people who conceived these spacecraft have fantastic minds," says Fritz Runge, manager of user integration and commercialization. "I am amazed at their overall grasp of the complex stories they want to tell and the environments they want to create and the thoughts they want to stimulate. Most of us are envious of that kind of imaginative stuff."

Harry Wolbers, who as deputy director of flight crew systems oversees the integration of human and machine on the station, says that the film stories "convey an image of future space systems to people, and anything that is in the mind of man will probably eventually be implemented. Maybe not exactly in the same way—just as Edward Everett Hale's 19th century concept of a space station was made of bricks and mortar—but in some form."

Brick and mortar may be too far out for them, but the McDonnell Douglas engineers won't dismiss out of hand faster-than-light warp speeds, antigravity drives, and ultra-intelligent computers—some of the movies' advanced concepts. "The more thoughtful scientists are, the more humble they are about how little we know and how much we have to discover," says Robert Wood, director of the space station's advanced systems and technology. "While many eminent scientists say that faster-than-light travel or interacting with gravity is impossible, what they really should be saying is, 'We don't really know how to do it.' "

Rather than being overambitious, the films were scientifically timid in many ways, the engineers say. "HAL [*2001*'s computer] was too big," says Wood. "He was whole racks of stuff. All three of these craft were very conservative with respect to what's happening in optics and computers. Based on the trends I've seen, in another hundred years optical computers, in which the calculations are done with light, will be almost magical devices, they'll be so powerful and compact. Many universities have already set up laboratories to develop such systems."

Runge maintains an open mind about the future possibilities because of past examples. His father, a German naval officer, attended the first radio school in 1909. "On his ship he worked in a room full of equipment that glowed purple, because of the electrical inefficiency of the early equipment," Runge says. "His buddies would look in fearfully and ask if he was all right in there. They couldn't believe that he was communicating with a ship that they couldn't see. So, far be it from me to say that warp drive is dumb or crazy, because there's so much going on even now that many of us don't understand."

Runge himself spent an entire career with the space program. "I remember 30 years ago I was given the unfortunate job of crawling up inside fully fueled Redstone rockets to stick the igniter inside the engine nozzle," he says. "I used to be up in there, and I'd be amazed that within an hour all hell would break loose in this chamber, but in a totally controlled way."

Both the *Star Trek* and *Star Wars* universes boasted technologies far beyond the Redstone, including a propulsion system with the ability to surpass the speed of light, which scientists today believe is impossible. But the McDonnell Douglas engineers still wonder: "Maybe it's like breaking through the sound barrier," Runge muses. "The faster you go, the harder it gets and the greater the drag, until you break through and then it gets easier. Maybe once we get to the speed of light, on the other side it will get easier." In fact, Wood believes that the galaxy-roaming *Enterprise* would have to be faster. "If you figure their maximum speed is warp 8 [512 times, or eight to the third power, the speed of light], it's not fast enough to go the places they go. They need the transwarp drive described in *Star Trek IV.*"

Both the *Enterprise* and the *Millennium Falcon* also apparently took advantage of some kind of gravity interaction. Wood notes that the crews of both ships enjoyed constant 1-G environments, and that the *Falcon* in particular made high-speed turns that would have created pilot-crushing G forces. What's more, the space epics featured ground vehicles and freight handlers that used antigravity for lift. "And obviously, since they can accelerate to the speed of light in a few seconds, they've eliminated inertia," Wood says.

How do the three spacecraft rate structurally?

The engineers think the *Discovery* the most reasonable configuration, based on today's technology. In the film, directed by Stanley Kubrick from a

*Han Solo's* Millennium Falcon *flew through space like a hot rod, but its external accessories could have created problems in an atmosphere.*

screenplay by Kubrick and noted science fiction author Arthur C. Clarke, the *Discovery* had been sent on an exploratory mission to Jupiter with a crew of five: three astronauts in hibernation and two to man the ship during the journey. Because the mission would take many months in the zero-G environment of space, the ship had a constantly rotating control deck that could simulate Earth gravity for the crew.

The *Discovery*'s long, arrow shape, which ended in the spherical control area, draws praise from the engineers, who worry about stability in flight. "It's a lot like our space station, which during the construction phase will fly like an arrow down the flight path," says George King, a specialist in spacecraft configuration designs.

But even the *Discovery* had its share of shortcomings. For instance, while the ship had a large antenna for vital communication with Earth, it lacked devices to scan the space ahead, an obvious necessity for a ship on an exploratory mission. "Either they should have had more large-area receiving dishes," says Runge, "or some whizzy words about why they had this little detector made out of some 'unobtanium' crystal that meant they didn't need the antennas."

Gene Burns, an expert in docking mechanisms, points out that the *Discovery*, which had been built in Earth orbit, was also overpowered. It boasted im-

ROBERT McCALL, COURTESY TURNER ENTERTAINMENT CO.

*Constructed in Earth orbit,* 2001*'s* Discovery *came equipped with pods for extravehicular jaunts.*

pressive booster-type rocket engines, rather than the smaller thrusters it would actually need. "Much smaller rocket motors are used for accelerating a spacecraft in space than are needed for Earth liftoff," says Burns. "For example, the half-million-pound space station will use 25-pound thrusters for orbit-keeping."

Ironically, even though the *Discovery* was the only ship with a totally peaceful mission, the engineers think that it would have made the best warship. "You want a warship to have the smallest possible radar cross-section for anything ahead of or behind it, so a hot dog shape is the best warship shape," says King.

The engineers may admire *Discovery*'s practicality, but it's the *Millennium Falcon,* with its slightly disreputable, used look, for which they have the most affection. "It looked like a bucket of bolts, but a very complex bucket of bolts," says Wolbers.

Wood appreciates the vessel's saucer shape for three reasons. First, he says, the UFO-like shape communicated the idea of advanced technology to the audience. "Secondly, the saucer shape gives you a nice lift-to-drag ratio for aerodynamic maneuvering," he says. And finally, the *Falcon* reflects a McDonnell

Douglas study that showed that a flying saucer might be a good idea, at least for atmospheric maneuvering.

"Years ago I was in charge of a project to investigate new propulsion schemes, and we took a look at the possibilities of the Earth's magnetic field," Wood says. The engineers calculated that a gigantic saucer shape, encircled laterally by a band of superconducting material, could hold a huge electric charge and create a powerful electromagnet that could counteract Earth's fields. "We concluded that you could actually consider building a big saucer that would float in the Earth's magnetic and electric fields," says Wood.

King does have reservations about all the structural problems presented by the *Falcon*'s external gadgetry—the antennas and other equipment. "Where you've got things piercing the hull, you've got to beef up the structure. Otherwise, you introduce a weak spot in the pressure vessel," he says. The space station hull, says King, will have little attached directly to it. Instruments and hazardous components like batteries will be mounted on the truss structure, with only a few wire bundles penetrating the hull.

The *Falcon*'s attachments would also create problems when the ship entered a planet's atmosphere, unless the vessel possessed a drive that would permit a very slow entry. "If you assume some sort of gravity interaction, the pilots just set the throttle for 50 miles per hour and enter a planet's atmosphere slowly," declares Wood. "For them, heating is no big deal."

With the *Enterprise,* the engineers worry most about the arrangement of its engines. Unlike the *Falcon,* whose engines were aligned across the rear of the hull, the *Enterprise*'s main engines were mounted high on separate pylons. But the pylons appeared too weak to handle the engine thrust, requiring additional struts from the engines to the ship's saucer-shaped main body. Even worse, the engines' thrust line did not go through the craft's center of gravity. One burst of power and the *Enterprise* would have plunged into a series of forward somersaults.

However, says Wood, the thrust vector problem might hold only for the low-power impulse engines, not the warp drives. These faster-than-light engines might operate outside the laws of physics as they are known today, and could envelop and propel the entire vessel.

How about the spaceships' interiors? "The *Enterprise* looks like a pretty reasonable design to us in terms of man-machine interfaces," says Wolbers, who appreciates the number of data display panels in the design. "We get about 80 percent of our information through the sense of sight, and that's not going to change." Even in the 23rd century, he says, man is "still going to have fingers and ears and eyes, and he'll still want to use them as efficiently and effectively as he can. In the future, we'll have auditory and tactile displays and even more exotic types, but we'll still rely very heavily on visual displays. The kinds of large-screen and 3-D visual displays you see in *Star Trek* are not too unrealistic." In fact, says Wolbers, before the *Star Trek* movie series began, the screenwriters and movie researchers came to McDonnell Douglas for advice on designing the operations stations.

The engineers do suggest, however, that if the *Enterprise* consoles swung out for servicing, as those on the space station will, the crew wouldn't have to grub around in the innards of the control panels, frantically making emergency repairs as the imperiled ship plummeted toward some planet.

They also suggest that the *Enterprise* should replace its automated sliding doors: the complex doors take up too much room and add weight. On the space station, sliding curtains will do when the astronauts need privacy. It's doubtful, though, that the intrepid *Enterprise* crew members would get the same dramatic effect upon entering a room after sweeping aside a glorified shower curtain.

The irony of their work, say the McDonnell Douglas engineers, is that actually designing and building a space station is not too technically challenging, because space itself is not an environment that demands the ultimate in technology. "A space station is about like a giant civilian aircraft, in terms of complexity," Runge says. The reusable space shuttle, on the other hand, must take the punishment of launches and landings, and it pushes hard at existing knowledge. "The shuttle is a screaming hot rod with all kinds of wild pressures, rpm's, and temperature excursions," Runge says.

That doesn't mean that designing the space station will be easy. But this group of engineers will look to Hollywood's space epics as a special kind of design inspiration. After all, these craft have been engineered to carry the most precious cargo we possess—the human imagination.

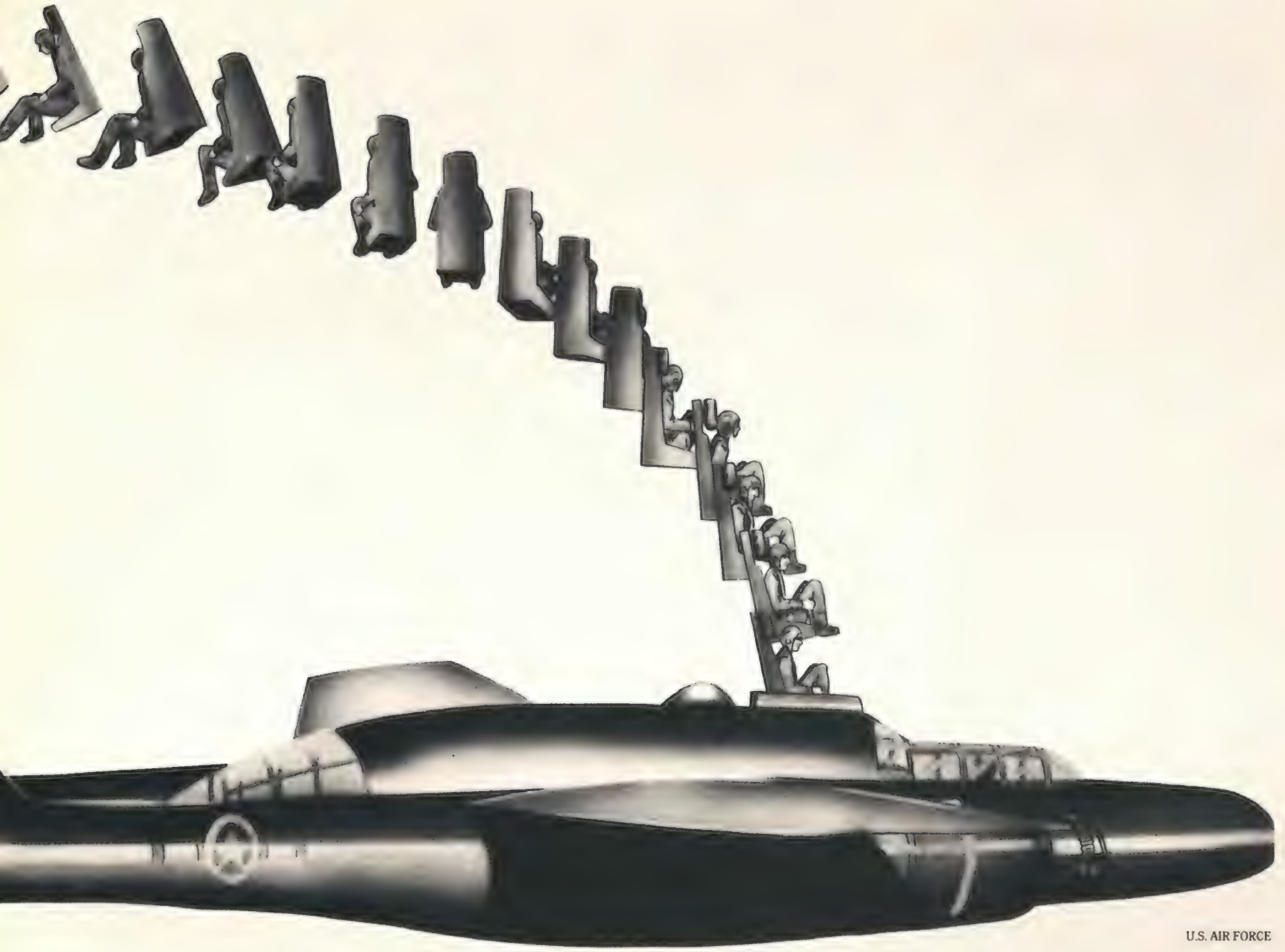
# *Chariots of Fire*

## For a pilot in a doomed jet, the best seat in the house is the one he leaves with.

by Jay Stuller

Suddenly the training exercise was no longer routine. It was July 1987, and Air Force captain Ben Bitler was flying an F-16 Fighting Falcon 3,000 feet above rugged terrain in Jordan. He was 24 miles from the nearest airstrip when his engine quit. The 31-year-old pilot twice tried to relight the engine but failed. Doomed by its fuel pump, the F-16 continued to drop. At less than 1,000 feet and moments from disaster, Bitler tightened his lap belt, then reached down for a yellow handle and gave it a hard jerk. Within two seconds—today a virtual blank in his memory—the canopy blasted away, a rocket beneath Bitler's seat catapulted him out of the fighter, and he was dangling beneath a full parachute.

The pilot watched as his F-16 crashed and exploded into a fireball, but nonetheless he felt elated at his flawless escape. *This is great!* he thought. Except for a few bruises from an inelegant "standard fighter pilot parachute landing," Bitler returned unscathed to his wife and young daughter back in South Carolina, his confidence in the ejection seat confirmed. "I told everyone in my squadron that I've got a lot of respect



U.S. AIR FORCE

for the seat," he says today, "and would not hesitate for an instant to use it in the future."

Some fighter pilots would hesitate: while it's often the only way to escape a fatal crash, blasting your seat out of an airplane holds little appeal. Yet few pieces of equipment have so dramatically improved the safety of military aviation. In fact, since the seats were deemed operational in Air Force fighters in 1949, ejection survival rates have consistently averaged around 80 percent. Air Force statistics suggest that for pilots who try to wrestle their airplanes down when they should eject, the odds of surviving are roughly 15 percent or less.

The rush to develop an American ejection seat began in the waning days of World War II at Wright Field in Dayton, Ohio, as a joint effort by the Army Air Forces' aircraft, personal equipment, and aeromedical laboratories. By war's end the need for the seat became even more acute: as the nation entered peacetime, lives were being lost in the new breed of jet fighters. Engineers, physicians, and ballistics and parachute experts raced to fashion a new escape system.

The new high-performance jets, such as the Lockheed P-80 Shooting Star, were capable of reaching 600 mph, faster than almost any propeller-driven airplane. Such speeds made over-the-side bailouts difficult, if not frequently impossible.

Even the conventional fighters of World War II presented serious problems. A study of 2,500 emergency over-the-side bailouts made from 1943 to 1945 showed that 58 percent resulted in injuries or fatalities. The study found that a quarter of the deaths came when airmen struck sections of the craft. Moreover, centrifuge tests showed that acceleration forces of just 2 Gs—common in a spinning, out-of-control aircraft—virtually pinned pilots in the cockpit. Given the speed of jets, an ejection seat was clearly needed.

Not only did the Wright Field researchers have to struggle with somewhat primitive ballistic systems and the uncertain

*The first American ejection would be from a P-61 Black Widow. Was the airplane's name an omen?*

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aerodynamics of ejecting a fighter's seat, they also weren't sure how well a human would tolerate the brutal acceleration forces and sudden airloads of a high-speed ejection. The program needed volunteers to prove—before Ben Bitler was even born—that riding a chariot of fire could indeed save a pilot's life.

The notion of an ejection seat had been around since at least 1910, when a Professor J.S. Zerbe of Los Angeles designed one for an airplane he'd invented. While the airplane wasn't a great success, a test of the powder-charged gun beneath the seat did hurl a dummy from the craft.

The idea lay fallow in the United States until the late 1930s, when aircraft manufacturers developed several new fighter prototypes, including the Bell Aircraft SFM-1 Airacuda and Vultee Aircraft XP-54 Swoose Goose, that were "pushers"—their propellers were located behind the cockpit, not in front of it. Because the pushers' props blocked escape, pilots mordantly called them "meat grinders."

Several systems were considered for getting pilots around the menacing blades. One scheme used explosives to blow the propellers free, allowing a regular bailout. The Swoose Goose had a seat with a pivoting arm that would dump the pilot through the cockpit entrance hatch beneath his feet. (Downward ejections make sense in a high-flying bomber, but when trouble strikes at low altitude, as it often does in fighters, such a seat would eject a pilot straight into the ground.)

Pushers, perhaps fortunately, didn't pan out, and in the United States further work on ejection concepts didn't begin until 1944. The Swedish and British governments had already begun developing systems, however, and the Germans, not surprisingly, had been at it since the late 1930s.

Near the end of the war, Allied pilots reported that German fliers had a means of ejecting from disabled airplanes. In fact, the Luftwaffe had tested or installed such seats in seven types of aircraft, including the rocket-powered Messerschmitt Me-163 Komet and the jet-propelled Heinkel He-162 Volksjäger, or "People's Fighter." The latter's seat consisted of a bucket mounted on four rollers that moved up a pair of 42-inch channeled rails. A pair of telescoping tubes—the inner one packed with a powder charge and attached to the airplane, the outer

*Gino Santi thought the captured German seats were primitive and that better devices were necessary.*

TERRY EILER


*Isadore Rosenberg helped both Larry Lambert and Vincent Mazza prepare for their pioneer ejections.*

CHAD SLATTERY

*Vincent Mazza's ejection at 555 mph convinced many Air Force pilots to use the new escape device.*

one to the metal seat—served as the catapult. The gases from the explosion in the inside tube propelled the outer tube, sending the seat up the rails and out of the airplane.

In May 1945, within days of the Third Reich's surrender, Americans from Wright Field arrived in Germany to get their hands on the Heinkel seat. They cut the cockpits, fuselage and all, from a trio of Volksjägers and shipped one to Ohio, another to the U.S. Navy, and the third to the British. They also discovered that the Luftwaffe had recorded 60 successful ejections; some German scientists called the seat their most important wartime contribution to flying safety.

The Wright team quickly learned that the seats weren't all that safe: an American sergeant who was supposed to be crating the shipment climbed into a cockpit, closed the canopy, and pulled the ejection trigger. He landed in a shower of plexiglass with both arms, a leg, and several ribs broken.

However, the 60 ejections the Germans made had apparently been almost as brutal. "The seat was very primitive, and most that survived had serious back injuries," says Gino Santi, a now-retired aeronautical engineer who was assigned to the Wright Field program in 1944. Later an ejection seat project engineer, Santi devoted his career to aircraft escape systems.

Santi, now 73, says that the German seat's major flaw was obvious. The catapult gun, which had a 28-inch stroke, used a fast-burning powder that could load nearly 15 Gs of acceleration force on the pilot's spine within 1/200 of a second, a fearsome jolt. But with a peak velocity of 40 feet per second, it seemed unlikely a Heinkel seat ejected from a fast-moving P-80 would clear the airplane's tail. The Wright group figured they'd need a velocity of 57 feet per second or more. "We worked with the Frankford Arsenal in Philadelphia on a catapult with slower burning powder and three telescoping tubes," Santi recalls. With a 60-inch power stroke, this new device spread the acceleration forces over a longer period of time, so the pilot wouldn't feel such a jolt.

Although the team members planned a careful series of test firings, they were rushed into their first shot. The commanding general of the Air Technical Service Command had ordered a huge, 10-day "county fair" at Wright Field in October 1945 to show off the stuff that won the war, along with enemy equipment, and some hardware of the future. The "future" was to include daily demonstrations of the ejection seat.

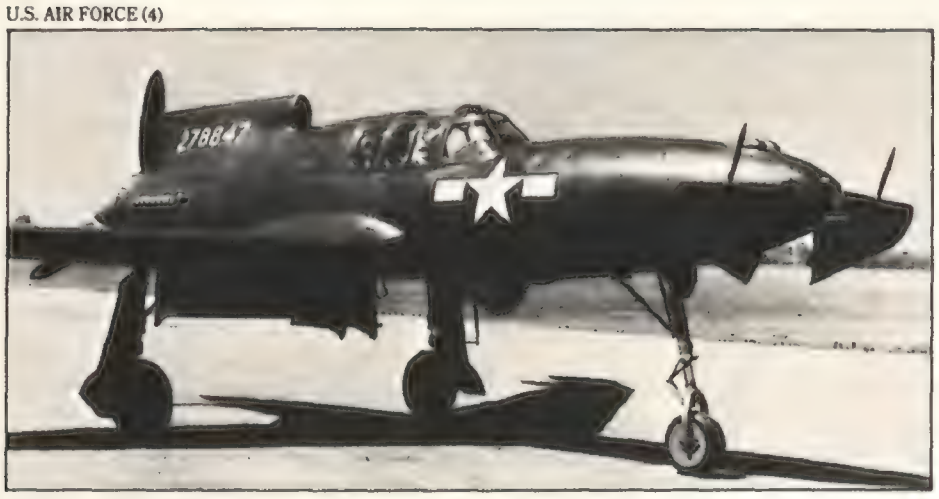
The catapult had never even been fired until the day before the fair opened. The seat, with a dummy as passenger, was rigged to a ground platform and aimed at a net about 60 feet away. When it was fired, the seat's rollers snagged on the rail; seat and passenger tumbled awkwardly through the air and smashed into the ramp short of the net. Workers hammered out the dents during the night, and the seat still made an appearance at the fair—as a static display.

For the next five months the Wright team methodically conducted firings on the ground, first from platforms, then from a twin-engine P-61B Black Widow, a propeller-driven night fighter. The P-61 was selected for two reasons: the seat could easily fit in the airplane's front gunner position, and it had a twin tail, which meant the ejected subject wouldn't have to clear a vertical stabilizer aligned with the center of the airplane.

*"I never* intended *to test an ejection seat," says Mazza, who nonetheless contributed mightily to its development.*

BOB ABRAHAM

U.S. AIR FORCE (4)




*Pusher airplanes, like the aptly named Curtiss Ascender, made bailing out a dangerous proposition.*

*The Luftwaffe installed and tested an early ejection seat in a rocket-propelled Me-163 Komet.*

In March 1946 the P-61 flew to Muroc Army Air Field in California for a series of 10 aerial dummy ejections at speeds progressing up to nearly 300 mph. It was there, in keeping with a World War II tradition, that the airplane received its name, the *Jack-in-the-Box*. Corporal Ralph Lenz, a former sign painter, lettered the name on the left side of the P-6's fuselage and painted a sprightly, popped-up jack-in-the-box on the other. After each of 10 aerial ejections, Lenz painted a small jack-in-the-box on the side of the aircraft. During two of the tests, however, parachutes failed and the dummies plunged straight to the desert floor; over the corresponding jacks, Lenz painted halos.

The halos didn't seem to frighten away volunteers for ejection tests. In fact, says Santi, "the guys in the parachute group would have fought each other to get into the program. These were the kind of people who felt this was a lot of fun." And at the center of the fun was an amiable West Virginian with a shock of dark hair, a wide, gap-toothed grin, and a gift for telling stories about exploits he'd never had—First Sergeant Lawrence Lambert.

"Larry Lambert was the lyingest son of a bitch I've ever known," says Isadore "Rosey" Rosenberg, 68, who is now retired and living in Downey, California. "He claimed he was a trained jumper with experience in the Pacific during the war. Ten years later I learned that he'd washed out of parachute school, served only briefly as a medic overseas, and, while re-



enlisting, had more or less talked his way into this assignment." It was up to Rosenberg, then a warrant officer with the personal equipment lab, to rig the parachute and release mechanisms on the experimental seat in preparation for Lambert's test.

The first test with a human subject took place on August 17, 1946. At 4:00 a.m. that morning Rosenberg arrived at Lawrence and Kaye Lambert's house on Third Street in Dayton to pick up the test subject. Pushing open the door, Rosenberg found his man in the bedroom, "stinking drunk from a late party. I told Kaye to make him some coffee and stuck Larry in a cold shower."

On the drive to Patterson Field in nearby Fairfield, Rosenberg tried to review ejection procedures with Lambert. "He said, 'Rosey, just leave me alone.' "

Lambert's hangover was one thing; the fracture of his right arm, suffered a week before, another. Desperate to be the first ejection volunteer, he'd covered up the injury, knowing that if an officer or flight surgeon spotted a forearm cast he'd be scratched. "Larry begged me to cut the cast off," says Rosenberg. "I was afraid I'd slice his arm, but he insisted." Appreciating Lambert's determination, if not his judgment, Rosenberg sawed it off that morning.

At the preflight briefing, it was announced that Lambert would eject directly over the field. "I protested, pointing out that if the winds picked up he'd land in the next town," says Rosenberg, who assumed that the system would work. The brass figured that if it didn't, it was better that Sergeant Lambert end up on military property than in a civilian's backyard. According to Rosenberg, the ejection seat simply *had* to work. The Navy was at work on its own device and "the test influenced which service got funds for development," he recalls. "At the time, we weren't telling the Navy what we were doing. The one to do it first would get the war department's money." (For many of its aircraft, the Navy eventually decided to adopt a seat made by the British firm Martin-Baker. In fact, the British, under the direction of Sir James Martin, ejected a volunteer from a modified Meteor III on July 24, 1946. Five days later, a Swedish pilot was forced to make an emergency

*August 17, 1946: Lawrence Lambert enters the* Jack-in-the-Box. *He was thrown out at 7,800 feet.*

*A jubilant Lambert, the first American to eject from an airplane, landed safely in an Ohio pasture.*

ejection from a pusher-propeller J-21A.)

"I strapped Larry into the seat, checked all the rigging, and still couldn't get his attention," says Rosenberg. "So I slapped him on the helmet and told him I'd see him on the ground." Not long thereafter, at an altitude of 7,800 feet and a true airspeed of 302 mph, the *Jack-in-the-Box* pilot pulled a trigger and blasted Lambert from the airplane. Within seconds he was free of the seat, chute open and drifting toward the town of Osborn.

Since the wind had picked up, Rosenberg and Captain Richard Barnes had to climb in a jeep and chase after Lambert. "He was headed for these two big smokestacks in a cement plant," says Rosenberg. "I thought he'd hit 'em, but he went right between." Lambert landed gently in a pasture.

The official record states that the test "went off perfect." Rosenberg and Barnes, the first to reach Lambert, heard a more accurate, albeit unofficial, report. Lambert told them that his lap belt didn't open automatically as it should have. "I grabbed the belt release," Rosenberg says, "quickly put in a spare battery, and found that it worked; the original had been flawed. We could see several jeeps full of Air Corps officers converging on us. We told Larry to keep his mouth shut, that we didn't want anyone upset and throwing a wrench in the program."

When the others arrived, Lambert just stood there grinning, basking in the praise. He said the ejection had been perfect, and that he'd "never felt it a bit." Ten days later Corporal Harry Brickheimer of the parachute branch made the second ejection; this time, the lap belt worked.

Lambert was given the 1946 Cheney Award, presented annually by the Air Force for an act of valor, and the Distinguished Flying Cross, and within a decade he was the chief test jumper at the Air Force and Navy's joint parachute test facility at El Centro, California, a rise in fortunes that still mystifies Rosenberg. "Larry died in the late 1960s or early 1970s, but even if he never told the truth in his life, he could sure sell himself," says the former warrant officer, with grudging admiration. "He was a real character."

While the tests proved an ejection seat would work in propeller-driven aircraft, the P-61B wasn't fast enough for high-speed trials. And by 1949, the new jets in service were crashing at alarming rates. Many operational airplanes carried the device, but since it was still considered unproven and too dangerous to use, it was flown unarmed.

While dummy tests showed the seats had the velocity to hurl pilots from jet fighters, the Air Force determined that only humans could conclusively prove ejections were safe up to speeds of 550 mph. The burden of proof fell upon Air Force captain Vincent Mazza of Wright Field's aeromedical lab.

Mazza had flown 30 wartime missions in B-24s over Europe and later trained bomber pilots in the States. Because he'd taken pre-med courses, Mazza was assigned to the Wright lab, and remained in the Air Force until 1969. Now retired and living in Honolulu, Mazza recalls, "I never *intended* to test an ejection seat."

"Physically and mentally, Vince Mazza was so oriented to-

### Dress Rehearsal

"Prepare to eject."

I check helmet position, secure oxygen mask, wedge hips back into the seat, lock and tighten the leg harnesses, and get a good grip on the black and yellow handle between my knees.

"Eject!"

Yank-*whoosh*-jiggle. It's over in about a quarter-second. By the time I realize I'm up, I'm already halfway back down.

"Good job. Give us a thumbs-up if you're okay."

I'm fine—just a bit startled. As the seat inches down the rail, the debriefing continues. "Did you feel your head come forward a bit? You've got to concentrate on keeping it back against the helmet rest."

I'd like to try it again, but the Navy allows only one ejection seat training ride per customer in a 24-hour period. Navy physiologists say the momentary 5-G jolt, which gives you the same rush in the rib cage as a good roller coaster, slightly compresses the spine.

Navy aircrews must take ejection seat training (with annual squadron refresher courses) at any of the 10 bases that have the trainer, a device that uses a blast of compressed air to send the seat and its occupant about halfway up a 14-foot rail. The class I attended used a Martin-Baker IF-3 escape seat, found in McDonnell Douglas A-4 Skyhawks.

Even though the G forces of the trainer are only one-third of those in an actual ejection, all trainees still need an "upchit"—a document, signed by a flight surgeon, stating that you are healthy enough to become a lifesize jack-in-the-box. Back problems, high blood pressure, and pregnancy are automatic disqualifiers.

To get the upchit I spent three hours working my way through the warren of labs at Maryland's Patuxent River Naval Hospital. I got a dental exam, chest X-ray, audiogram, eye exam, body fat measurement, pelvic exam, EKG, and a raft of blood tests, including CBC, RPR, HGB, G6PD, BUN, HDL, and probably MPG and RBI for good measure.

After a chat-and-poke session with the flight surgeon, there's a 45-minute class in ejection seat mechanics and physiology. We learned that the greatest danger lies in ejecting "outside the envelope"—too late or too low for the rocket-powered seat to clear the aircraft and automatically deploy a parachute, all of which takes three seconds. Though almost all of today's seats are rated "zero-zero"—no altitude or airspeed required—Patuxent's aerospace physiologist, Lieutenant Jon Etheredge, says that should not be interpreted as guaranteeing a safe ejection from any configuration. The ballistics involved in ejecting from an aircraft that catches fire while sitting on the runway are far more survivable than those of an aircraft in a steep dive about to hit the ground. "If you're out of control and below 10,000 feet, eject," says Petty Officer First Class Stan Kosinski, an instructor in Patuxent River's aviation physiology department.

The second greatest cause of injuries and fatalities is improper body positioning. Helmet not wedged against the seat back? Dislocated vertebrae or even a broken neck can result. ("The head weighs about 15 pounds—add two pounds for you fighter pilots," says Kosinski, "plus about five pounds of equipment. So for .16 seconds at 200 Gs at initial ejection, it weighs 4,000 pounds. You've got to get that head back and keep it there.") Arms not pressed into ribs? "Flailing" injuries occur when the wind transforms them into airfoils. Thighs not pressed against the seat cushion? "Seat slap" bruises result when the seat catches up with you in mid-flight.

There's a fair amount of mechanical preparation and a large amount of psychological preparation involved in a safe ejection. The training attempts to make it all reflexive. The ejection seats are nearly 100 percent reliable—it's the human factor that accounts for the five to 15 percent ejection fatality rate. Of the 69 Navy fliers who ejected in 1987, 61 survived. And of the eight who died, six made the decision to eject just a second or two too late.

That decision is fraught with fear—of the unknown, of losing your airplane, your career, your life. As Jon Etheredge puts it, "Who wants to leave a nice warm cockpit for 400-mph air at 20 below zero?" The enormous surge of adrenaline triggered by such a traumatic experience causes many fliers to lose all recall of those first few seconds.

But that didn't happen to Lieutenant Bill "Catfish" Davis, who ejected when a faulty catapult caused his A-6 to roll off the deck of the USS *Kennedy* one night in January 1984. "I remember looking down and seeing the rocket fire and realizing that my head wasn't in the proper position," he says. But Davis classifies his ejection as "pretty benign"—he landed on the carrier without so much as a sore neck.

Davis had gone through ejection training, but he says he never gave it much thought until he read about other incidents—collapsed chutes, crews who'd gone off the front of the ship and been dragged under. "They should have someone who's ejected at the training sessions," he says. And what would he tell the trainees? "Read ejection stories. Think about it before it happens. Have a plan."

*—Patricia Trenner*

ward being a good officer, never saying an evil word about anyone, always reporting just the facts, studying and preparing for tests .... Well, he was exactly the opposite of Lambert," says Rosenberg. "He was also such a patriotic guy."

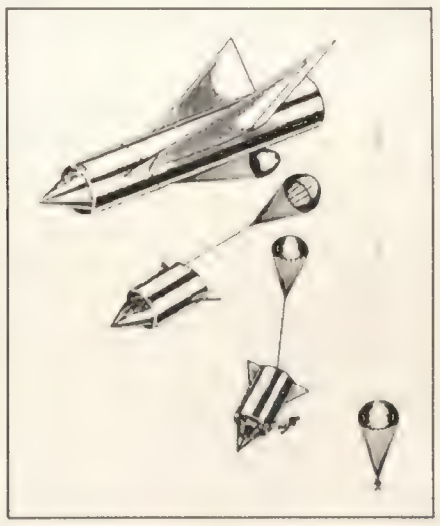
Which may explain why Mazza volunteered to eject from a TF-80C jet, a version of the P-80. "I was down at Muroc for the *Jack-in-the-Box* tests and got to know and fly with some of the pilots there, including Chuck Yeager and Bob Hoover," says Mazza. "One day, Hoover was flying a P-84 with an ejection seat and had a flame-out. The seats in experimental planes were armed, and before he went up I told him to use it if needed. But instead, Hoover climbed out over the side. He survived, luckily, but broke his legs." These pilots, concluded Mazza, needed convincing.

Back at Wright Field, Mazza received rudimentary jump training. He and Victor James, a rakish cigar-smoking staff sergeant, would make a series of high-speed ejects from the TF-80C over San Pablo Bay, just north of San Francisco. "I insisted on a water bailout," says Mazza, "because it would minimize the chance of landing injury and we'd be easy to spot and recover. Some of the equipment had been lost in the desert at Muroc, and I didn't want to be lost."

On May 31, 1949, with recovery boats in the bay and several photo and chase aircraft in the air, the TF-80C prepared

U.S. AIR FORCE (3)

*Downward ejections were tested in B-47s. This method could have been deadly at low altitude.*



*The Air Force also studied escape capsule shapes and concepts (left); one was planned for an XP-92 rocket craft that was never built (right). A B-1 capsule was eventually abandoned, while the General Dynamics F-111's capsule is still in use today.*

to take off from Hamilton Air Force Base. While checking the parachute and release mechanisms on the seat, Rosenberg noticed with amazement that Mazza appeared quite calm. "They took his pulse and blood pressure before this major jump," he recalls, "and it was like he was about to go to sleep."

Mazza, however, admits to jitters once the jet reached the eject area. "I couldn't see very well from the back seat, and it was awfully noisy in there," he recalls. "There was this red light the pilot was supposed to turn on 10 seconds before he pulled the trigger. To the side of the cockpit, about arm's length away, was a switch I could pull that would turn off a red light in the front to let the pilot know I wasn't ready. When the light came on, I'm thinking about all that can go wrong, but realize that if I reach out now for the switch and the seat fires, I might lose an arm."

At 5:00 p.m., 10,000 feet over San Pablo Bay and at an airspeed of 430 mph, Major Vernon Ford pulled the trigger that catapulted Mazza out of the jet. The windblast blew his helmet and oxygen mask askew, but Mazza easily pushed himself away from the seat and was soon under an open chute. Just 51 seconds after ejection, he hit the water and was immediately pulled into a boat.

Mazza later described the experience to a reporter for the *Detroit News*: "Suddenly, a giant has simply shot-putted you into space at 60 feet per second and there you are, sitting on air."

On June 2, James went out at 405 mph. Mazza then ejected at 480 and 535 mph. "After that first experience with the red light," he says, "I rigged a string to my switch, but forgot to tell the pilot. When I went out the second time, the string went too, turning out the light in front. The pilot thought he'd fired

me when I wasn't ready. Scared the hell out of him."

Finally, on July 5, Mazza ejected from an altitude of 9,000 feet and an airspeed of 555 mph. "I sweated out that one a bit," he admits. Following their experiences, the brass immediately sent Mazza and James on a tour of bases to convince pilots that it would be safe to "pull the handle." "We ran into a lot of negative comments initially," recalls Mazza. "But we'd show 'em pictures and film of how they couldn't get out of the cockpit if they were pulling a couple Gs, and films of our ejections."

On August 29, 1949, Lieutenant Robert Farley of the 71st Fighter Squadron became the first American to use his ejection seat in earnest. With his F-86 Sabre in a steep inverted dive, plunging downward at about 550 mph and only seconds from impact, Farley punched out. Although injured, he survived. Another pilot who ejected later told Mazza: "If it hadn't been for you, I wouldn't have pulled the trigger."

Since then, thousands of others have owed their survival to the ejection seat. While pilots still risk injury from deceleration forces and windblast during an ejection, seat technology has advanced along with that of high-performance aircraft. And the influence of Wright Field's pioneers is felt even today. Mazza and James were among those who tested high-altitude escapes during the 1950s. Mazza helped develop and test the survival gear that goes along with an ejection seat, some of which he looks on "as more of a contribution than ejections and altitude jumps." Designers at Wright also developed escape capsule concepts, such as the encapsulated seat used in the B-58 bomber. (The only capsule currently in use is the F-111's crew module. While it protects fliers from windblast and "flail" injuries like broken arms and legs, a module parachute can take over 10 seconds to fully deploy.) And it was Gino Santi who played a major role in developing specifications for the McDonnell Douglas Advanced Concept Ejection Seat (ACES) II, the seat ridden by F-16 pilot Ben Bitler.

"One of the most important developments were the rockets that came along in the late 1950s and eventually replaced ballistic catapults," says Santi. The first rocket catapult installed in an F-102, for example, reduced the acceleration on a pilot to 15 Gs at an onset rate of 122 Gs per second. A comparable ballistic seat, with the same 60-feet-per-second escape velocity, loaded 20 Gs at a painful onset rate of 170 Gs per second (sustained loads too much above 20 Gs could result in serious injury to the pilot). Moreover, rocket nozzles could be vectored to give the seat a trajectory and attitude that minimize windblast and deceleration trauma.

Modern seats such as the ACES II and Martin-Baker Mk14 have sophisticated guidance systems and performance characteristics that automatically vary with the airplane's speed, altitude, and situation. Developed in the 1970s and now found in Air Force F-15s, F-16s, A-10s, and B-1Bs, the ACES II, for instance, with an envelope from zero to 600 knots (690 mph) airspeed, is known as a "zero-zero" seat. That is, it's designed to get the pilot under a parachute even if the craft is out of speed and altitude—sitting on the runway in flames, say. But it's clear that the best seats don't guarantee survival: even a rocket-powered zero-zero seat can't overcome a rapid sink rate at low altitude. For example, of the 79 pilots and crew members who ejected from Air Force craft during 1987 and 1988, 20 died; of these, 15 were out-of-envelope ejects.

Even better ejection seats are on the way. Under contract to the Air Force, Boeing is working on a new Crew Escape Technologies program—the CREST seat—with an envelope of 700 knots, advanced sensors, and improved windblast protection. But for all its 1980s technology, the CREST's lineage can be traced straight back to the Heinkel and Wright Field catapults.

"Not many pilots ever have to eject," says Ben Bitler. "But when a guy like me does it, it makes an impression on the other guys, so maybe they won't hesitate in the future." Until recently, Bitler had never heard of Lawrence Lambert or Vincent Mazza. Today he is profoundly impressed by the demonstrations they volunteered to stage four decades ago—and with the chariot that can propel a pilot out of danger and leave him, as Mazza once said, "sitting on air."

*Once the object of speculation, ejection seats have become indispensable to military aviation.*

COURTESY POPULAR MECHANICS


*The McDonnell Douglas ACES II seat uses rockets that can control the direction of the seat's flight.*

# "The Greatest Record of All"

"San Diego Fliers Soar Home From Atlantic to Pacific in 27 Hours," trumpeted the *San Diego Union* morning edition of May 4, 1923. The first nonstop flight across the United States had ended at our own Rockwell Field the day before, and the excitement was rippling through the entire city.

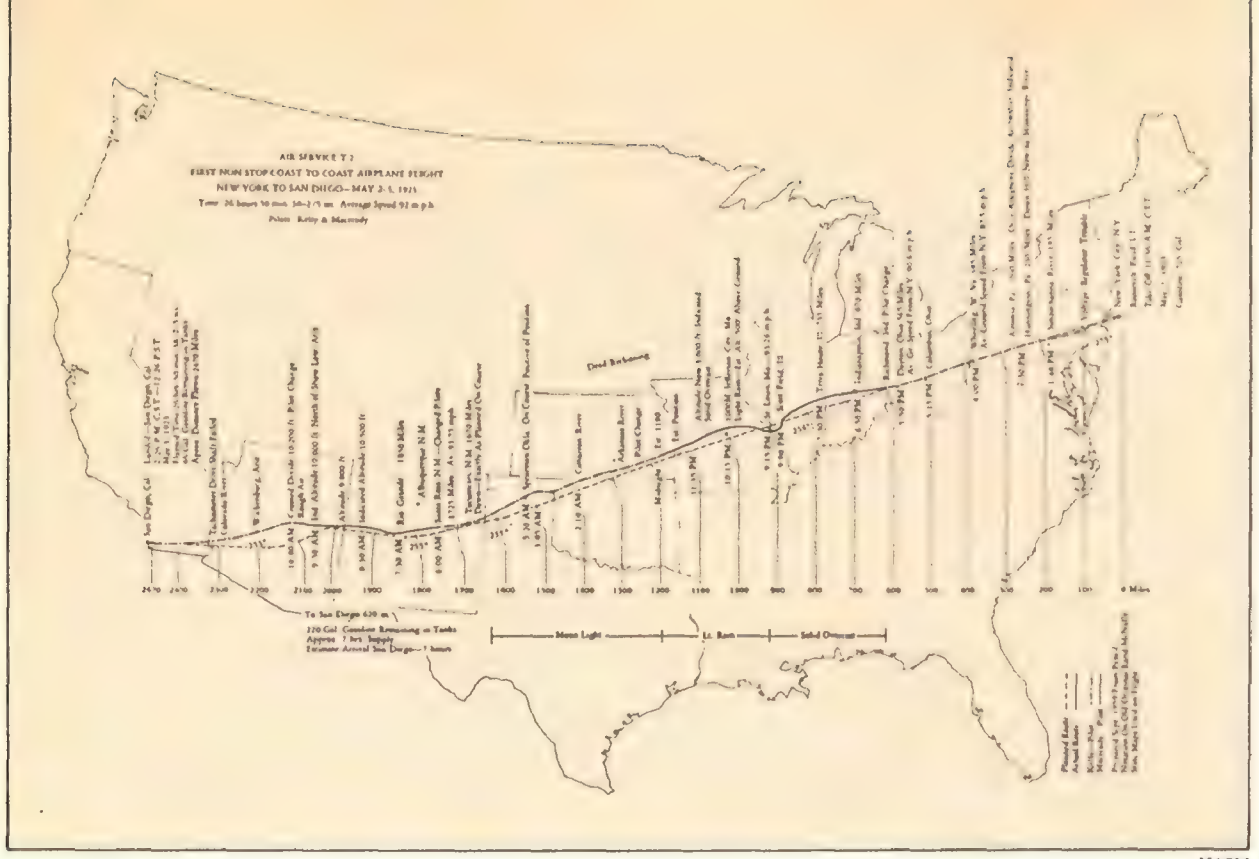
The mood in our aviation-minded household on the morning of May 3 had been both hopeful and anxious. The last news we'd heard was that Army Air Service lieutenants Oakley Kelly and John Macready had taken off from Long Island's Roosevelt Field around noon on May 2 on their third try for a record flight—this one east to west. Their Dutch-built Fokker T-2, with its reinforced wing, auxiliary radiator, oil and water tanks, dual controls, and additional 600 pounds of fuel, barely got airborne. On the second run, despite a bit of a tailwind, it rose just high enough to clear a group of hangars before passing out of sight. Now we wondered: Were they really still in the air after almost 24 hours?

My husband Bill, a pilot in the reserves, had been on the phone early that morning lining up a ride to the airport to greet the flight. The T-2's first attempt, going west to east the previous October, was planned to take advantage of the prevailing winds, but Kelly and Macready ran into dense fog 50 miles east of San Diego. Rather than admit total defeat, they'd gone on to set an endurance record of 35 hours. On the second try a month later, mechanical failure forced them down near Indianapolis.

Bill was flying with the Army Air Service reserves at Rockwell Field and the previous fall had met Kelly and Macready, the latter a hometown boy, during preparations for those first flights. Bill and fellow reserve pilot Leslie Sherman planned to

*Macready (inset, left) and Kelly (right) switched open-cockpit duty five times during their historic flight.*

NASM




NASM

*The ungainly Fokker T-2 covered the 2,470 miles from Long Island to San Diego in an unheard-of 27 hours.*

commandeer an Army JN-4 and meet the Fokker over San Diego. Now Bill reported from the front porch, "No pea soup today. They should get over our mountains okay." Then he asked, "Can we hurry a little—maybe leave earlier? I could call Les . . . ."

By the time we got to the airfield a large and enthusiastic crowd had gathered near a runway that had been extended to two miles for the T-2's west-to-east attempts. Bill and Leslie were in a fever to be up and away but were soon back at the car. "No word—maybe not till afternoon. Of course, only a note dropped from the plane or a reported sighting could tell us anything." And they were off again.

Linda Sherman and I joined the rest of the ground-bound. At each false alarm, the crowd would swivel to the east. "I think I see . . . over there . . . "—but nothing.

Shortly after noon the T-2 suddenly appeared, low and fast over downtown San Diego. The voices of the crowd rose in a chorus of welcome as it circled above. With the engine throttled down and the propeller spinning silently, it touched down, kicking up a plume of dust, and rolled toward the crowd that rushed to meet it. Streaked with oil and dirt, the T-2, with its lanky fuselage, broad, fat wing, and tiny tail, lacked the grace and beauty of more modern aircraft but seemed to bask in the cheers of the revelers. Field personnel charged with crowd control were swept aside, and when the door to the T-2 opened the two men who emerged were thrust high above the crowd and carried off on shoulders.

Although doctors had voiced concern over the strain of such a flight, the pilots, as grimy as their airplane, seemed in good spirits. They later admitted to being surprised and a little frustrated over this long and noisy welcome. They wanted merely to talk to each other—the roar of the engine had made conversation impossible during the 2,470-mile flight. The pilot had sat alone in the open cockpit while the man on relief had the cabin. A few scribbled notes had sufficed, but now there was much to say to each other.

Army Air Service officers soon extracted Kelly and Macready from the well-wishers and established enough quiet for speeches to be heard. Henry ("Hap") Arnold, shaking hands, was quoted, "The impossible has happened." Linda and I were pressed back but caught bits of information passed from person to person. The huge bouquet and banner came from the Kiwanis Club . . . there was something about a Thermos of coffee . . . a doctor was waiting to check their condition . . . lunch would be at Major Arnold's after a shower and news conference . . . a big commotion downtown, where crowds on rooftops had gone wild when the T-2 banked and swooped about 100 feet over the buildings on Broadway. Now bright orange telegrams began to appear—from President Harding and Anthony Fokker, among others—along with cameras and newsmen.

The fliers had gone and the crowd had thinned by the time Bill and Leslie returned. They had escorted the T-2 the final 12 miles to Rockwell and extended their congratulations to Kelly and Macready. Now out came our Kodak for pictures of the T-2, the Shermans, and me, in my green linen dress and a big Milan straw. I was a little drained from all the excitement but the crowd still buzzed with talk about "the greatest record of all."

"One more stop," Bill said, gesturing to the *New York Times* he carried. "Major Arnold suggested I make a delivery downtown."

In the car the men laughed over the effect the Thermos, filled with coffee still hot from New York, had had on the reporters. Bill mentioned its use on the second west-to-east attempt. The airplane had cleared the coastal mountains, barely scraped over the San Andres range, and had reached Indianapolis when Kelly discovered that a sudden rise in engine temperature was due to several leaking cylinder jackets. By pouring all liquids on board—coffee, water, soup—into the cooling system, they were able to land safely at Fort Harrison.

Our downtown errand was explained in the next day's *San Diego Union*: "For the first time in history, a New York newspaper arrived in San Diego the day after it was published . . . . delivery at this end was handled by William Van Dusen and Leslie M. Sherman, air service reserve pilots."

Back home, we decided that our new Dodge, to date the most expensive purchase of our married life, deserved a name. We christened it the T-2, and a snapshot of its namesake hung on our wall for 20 years.

—*Helen H. Van Dusen*

*(In 1924 the War Department gave the T-2 to the Smithsonian Institution. It now hangs in the National Air and Space Museum's Pioneers of Flight gallery.)*

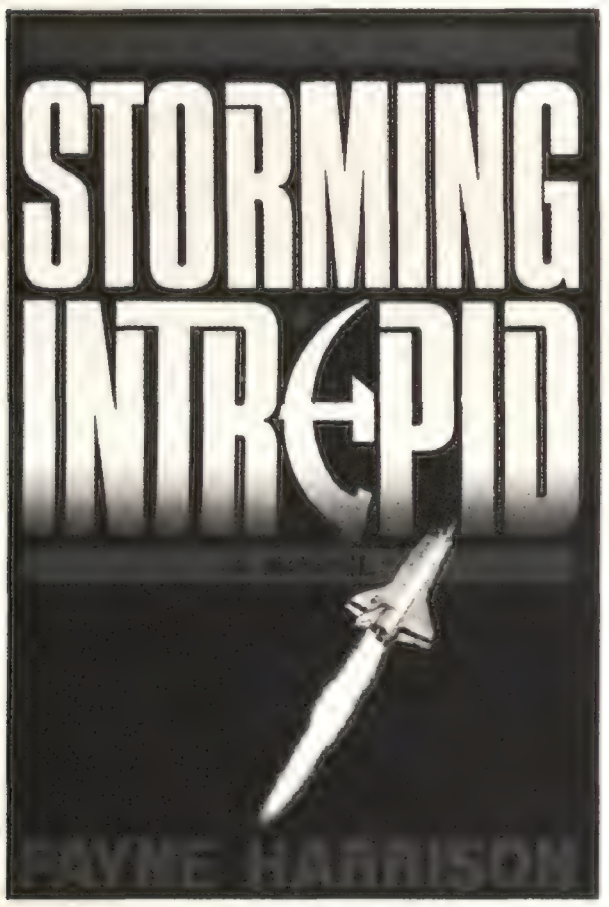
COURTESY HELEN H. VAN DUSEN

*The author, dressed for the occasion in "a big Milan straw," posed with the T-2 for a scrapbook photo.*

***Storming Intrepid** by Payne Harrison. Crown Publishers, Inc., 1989. 473 pp., $19.95 (hardbound).*

Imagine that a Soviet "sleeper" agent has had a stellar career in the U.S. Air Force, is now a top astronaut, and commands the space shuttle *Intrepid*. His mission: to hijack the shuttle and its vital cargo intended for the orbiting Strategic Defense Initiative platform and to bring the shuttleload of secrets to his masters at the Baikonur Cosmodrome.

*Storming Intrepid*'s Colonel Julian "Iceberg" Kapuscinski attempts to do just that when he murders his two fellow crewmen early in the mission. Before dying,




however, one of them damages key circuits that would enable the *Intrepid* to return to Earth, leaving Kapuscinski stuck in orbit with two corpses and the vital SDI components.

Over the next few days the Soviets and the Americans race to seize the shuttle, utilizing the most advanced air and space technologies. The Soviet Union sends up a Soyuz spacecraft to attach an expedient rig to the shuttle to enable its reentry. U.S. authorities send up another shuttle and an untested "space fighter" to recapture or destroy the *Intrepid*. The Strategic Air Command increases its alert to "DEFCON Two"—just short of war—and two B-2 Stealth bombers penetrate Soviet air defenses. Their mission: if all else fails, destroy the *Intrepid* and its cargo on the Baikonur Cosmodrome runway.

"In one brilliant stroke we will be on our way to parity with the United States," General Secretary Vorontsky compliments the KGB chairman as the story nears its climax. "Their spacecraft, their weaponry payload—it will all be ours." The endgame is the most interesting part of the tale.

Any story of high adventure, particularly if it is set in space and the future, requires some suspension of disbelief. In this age of the techno-thriller we do so willingly, but we still expect that the author will provide technical detail and likeable characters enmeshed in a thrilling plot. Payne Harrison's first try is a valiant one, but it falls short.

The intriguing plot contains enough twists and surprises to whet the reader's interest. But time after time the technological explanations detract from the story line rather than enhance it. In loading the story with technology, Harrison also occasionally stumbles on minor facts, such as powering the SR-71 with General Electric engines instead of Pratt & Whitneys. The spelling of "flight" as "flite" is another stumbling block. According to the publisher, the spelling is used intentionally in reference to Soviet activities to create an impression of foreignness. Instead, it impedes smooth reading of an otherwise exciting story.

With *Storming Intrepid*, Payne Harrison is off to a promising start. Perhaps his second novel, now in progress, will do more justice to his talent.

*—F. Clifton Berry Jr. has written on international defense and aerospace topics from Washington for 14 years.*

***The Berlin Raids: R.A.F. Bomber Command Winter 1943–44** by Martin Middlebrook. Viking, 1989. 407 pp., b&w photos, $24.95 (hardbound).*

"Strategic" is a word that made an early appearance in discussions about the use of air power. The idea of a force that could leap over opposing armies and navies and deliver a knockout blow to the enemy's heartland appealed to people haunted by the horrors of World War I trench warfare. When the theory was tested in the early days of World War II, however, the practice proved to be more complicated. The airborne instruments of destruction available in 1939 were inadequate to the task.

In his latest book, Martin Middlebrook examines the period beginning in the summer of 1943, when it still seemed that strategic air power was an idea whose time had finally come. The Royal Air Force's new four-engine bombers were at last carrying out significant strikes on German cities. Middlebrook takes a detailed look at what became known as the Battle of Berlin, shows how far the RAF Bomber Command fell short of achieving the war-winning aim, and confronts the difficult question of whether anyone even won the battle.

Middlebrook's research was obviously thorough. Much material not previously available in one volume has been gathered together to help paint a picture of a colossal struggle involving attackers, defenders, and the city of Berlin. Given the elemental nature of the fight, the extremes of fear, rage, and sorrow to which people were driven, and the awful aftermath, it is perhaps inevitable that Middlebrook's meticulous analysis could project only a pale image of the reality. He has viewed events from every angle and has included the reminiscences of many who were there, both in the air and on the ground, yet his telling of the tale often seems overly detached and dispassionate.

It may be that the physical limitations of the book and the style of presentation necessarily drain the color from such intense moments. Three important raids

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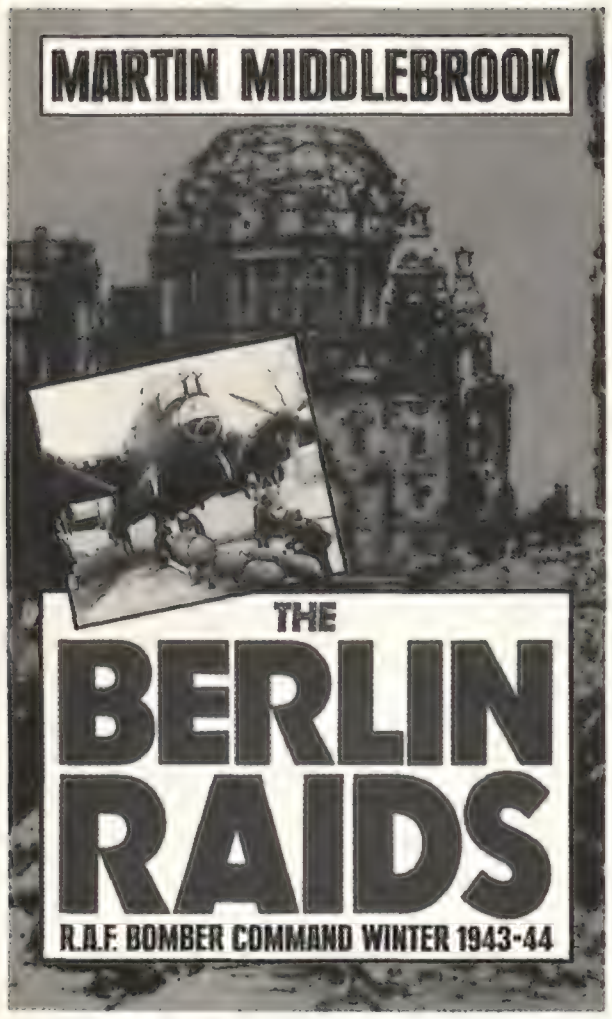



are covered in some detail, and the rest are summarized, a brief outline of each being preceded by its essential statistics.

On the other hand, many of the longer accounts of those who were there are lumped together in a section at the back of the book. The individual stories might have been better kept in context and the statistics annexed. A glossary of technical terms might also have been included, and places mentioned in the text marked on the maps provided.

That having been said, the essentials of the drama are all here: the grim determination of Air Chief Marshal Sir Arthur Harris and the stoic efforts made by the crews of Bomber Command in doing his bidding, the tense tactical struggle between offensive and defensive forces and the remarkable resilience of the Luftwaffe in overcoming early setbacks, the loneliness of death high over Germany and the sufferings of ordinary civilians on the ground. There is the terrible routine of non-combat losses—deaths that are "mishaps" or "little incidents"—and the shock of rediscovering that the average age of most of the bomber crews was no more than 20.

At the end, the RAF had to face the fact that in 19 major raids against Berlin, over 600 four-engine aircraft had been lost and nearly 3,400 aircrew members killed. The city had been badly hurt, but it was still there and the end of the war was a long way off. *The Berlin Raids* is a comprehensive and competent account of a failed attempt to realize the ultimate promise of strategic air power. It is also a somber reminder of the terribly destructive nature of war, even when it is fought with conventional weapons.

*—Air Vice Marshal Ron Dick, RAF (Ret.), is an International Fellow at the National Air and Space Museum.*

***Master of Airpower: General Carl A. Spaatz** by David R. Mets. Presidio, 1988. 430 pp., b&w photos, $22.50 (hardbound).*

General Carl A. "Tooey" Spaatz lived 83 productive years that would challenge any biographer. He was a fighter pilot in World War I and a commander and staff officer following the war. During World War II he was the leading commander of U.S. air forces in Europe and directed the strategic bombing campaign against Japan. The last commander of the U.S. Army Air Forces, he became the first chief of staff of the newly formed, independent Air Force, and following his retirement took to aviation writing.

David R. Mets covers it all in his smoothly written *Master of Airpower,* but he wisely focuses on Spaatz's World War II activities, devoting about two-thirds of his book to the three years when Spaatz was occupied in wresting command of the air from Hermann Goering's Luftwaffe and bombing Nazi Germany to near impotency.

Among Spaatz's many successes during the war, two are particularly noteworthy: his establishment of a new doctrine for command and control of tactical air forces, and his achievement of air superiority over Europe.

The first of these contributions was made in the North African campaign. Spaatz was Dwight Eisenhower's chief air lieutenant for Operation TORCH, the code name for the invasion of North Africa, and he was dismayed by the poor organization of his tactical air forces there. The airplanes were split into weak "penny packets" and placed under numerous ground commanders. When the Americans were defeated at Tunisia's Kasserine Pass in February 1943, it was because the Luftwaffe ruled the battlefield's skies.

Spaatz knew ground victory could not be achieved as long as the Luftwaffe commanded the air, and he knew that gaining control of the air would be impossible as long as the air forces were divided into small packages. Spaatz won Eisenhower's permission to reorganize all the air forces under his command and control, and he succeeded in driving the Luftwaffe from the air. With the German air force destroyed, Spaatz supported the ground forces as they squeezed Erwin Rommel out of North Africa.

In addition to his work in North Africa, Spaatz is most famous for directing the air campaign against the German homeland. Recognizing that an invasion would be required to win the war, he argued that its success would hinge on gaining air superiority over the continent. Never losing sight of this aim despite pressure from allies, other field commanders, and his boss at home, Spaatz pressed on until his goal was met. General Field Marshal Gerd von Rundstedt, Hitler's commander responsible for defeating the invasion, complained bitterly that Allied air supremacy utterly prevented him from driving the U.S., British, and Canadian forces into the sea.

An early advocate of an independent U.S. air force, Spaatz commanded the air campaigns that proved his point and was chosen to command the Army Air Forces after General H. H. (Hap) Arnold retired in 1945. Spaatz himself retired in June 1948—by then, as chief of staff of the independent U.S. Air Force.

A man of few words, Spaatz was a master of leadership. Students of the history of air power will find David Mets' telling of Spaatz's achievements a fascinating read.


*—Alan L. Gropman is a senior principal analyst for the SYSCON Corporation and a frequent lecturer on aviation at the Smithsonian.*

***Wings Over the World, a 13-part television series. Debuts on the Arts & Entertainment Cable Network on April 5, 9 p.m. EST.***

Wilbur Wright died in 1912 at the relatively early age of 45, but brother Orville lived long enough to sit briefly at the controls of a Lockheed Constellation. By then he had witnessed the dramatic evolution of the airplane from the fragile wood and fabric craft of Kitty Hawk to a machine with unmatched potential to change the world—or destroy it.

"Wings Over the World," a series of 13 hour-long episodes produced and directed by Stanley Hitchcock, is an attempt to study that evolution. Using the events of December 17, 1903, as a jumping-off point, the series deals with the people the Wrights inspired, a roster of names that includes McDonnell, Douglas, Boeing, Sikorsky, Lockheed, and Fokker.

That's a big expanse to cover, and the two episodes available for preview demonstrate both the pluses and minuses of filling in such a large canvas. The opener tells the story of the two companies that eventually became McDonnell Douglas. But by the time the two parallel narratives merge—when McDonnell buys out Douglas in 1967—the tale has become a corporate history that wouldn't look out of place in a company report.

Episode three, the Boeing story, suffers from the same problem. Any history that starts with William Boeing's first airplane and continues through today's will surely contain some fine airplane footage, and this segment does, including breathtaking—and horrifying—footage of B-17s being shot down over Europe. But the wide scope also forces the filmmakers to rush over much of the material. More controversial subjects, especially recent concerns about metal fatigue in older airliners, aren't mentioned at all.

The topics of other episodes include aviation in Sweden, Britain, and Italy; the story of the de Havilland Comet, the first jet airliner; the development of supersonic passenger flight; and a history of cancelled projects.

As an introduction to aviation history, the two previewed episodes of "Wings Over the World" are fine, even if their constant allusions to flight as a "dream" become tiresome. Buffs seeking in-depth studies of their favorite airplanes, however, are apt to be disappointed. It's a big world—and there's not enough time to dawdle too long at any one site.

*—Tom Huntington is the managing editor of* Air & Space/Smithsonian.

# *Credits*

**Lost in a Fighter.** Toby Elster is an Air Force veteran of World War II and the Korean War. He now works as a petroleum geologist in Wichita, Kansas.

***Plane People* Who Need People.** Alex Heard is a Washington, D.C.-based freelance writer.

Further information: To subscribe to *Plane People,* send name, address, and $12.00 to Aviation Singles, P.O. Box 551, East Hanover, NJ 07936.

**Gerry's World.** Al Reinert recently directed and produced *For All Mankind,* a documentary on the Apollo missions.

**Hell-Bent for Leather.** Derek Nelson is assistant editor-in-chief at the Naval Safety Center. As a freelancer for numerous publications, he writes frequently on beer, golf, and Sherlock Holmes.

Dave Parsons is editor of *Approach.* A radar intercept officer for the Navy, Parsons has more than 1,300 hours and 450 carrier-arrested landings in the F-14A fighter. In 1984 Parsons' leather flight jacket was stolen.

**When in Paris . . .** F. Clifton Berry Jr. runs an international aerospace information service. He has attended every Paris Airshow since 1975 and believes that the most important item to bring along is a pair of comfortable shoes.

**Space Island.** Berl Brechner is a longtime pilot and aviation writer.

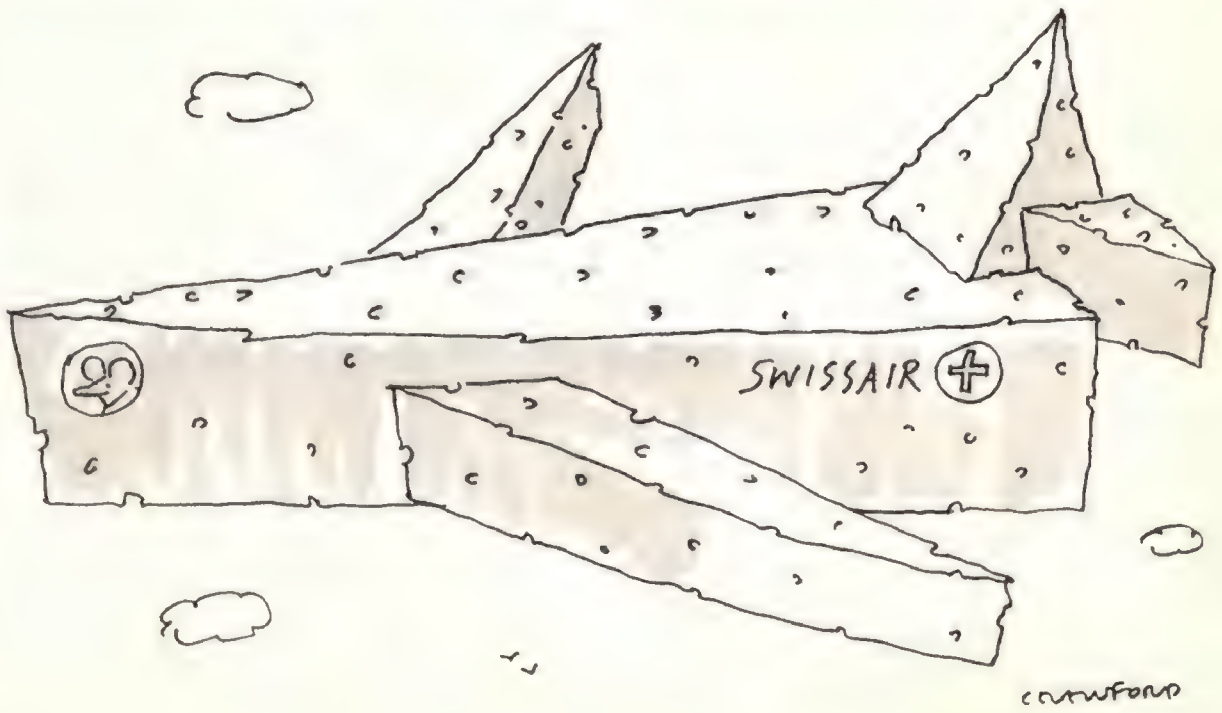
**Picturing Kenya.** Elaine de Man is looking forward to returning to Kenya, having been bitten by the Kenyan bug (non-malaria-carrying).

**Planet of Origin: Hollywood.** Dennis Meredith is science editor for Cornell University's news service.

**Chariots of Fire.** Jay Stuller is the co-author of *Through the Grapevine—The Business of American Wine,* to be published this spring by Wynwood Press.

**Dress Rehearsal.** Patricia Trenner is departments editor at *Air & Space/ Smithsonian.*

**"The Greatest Record of All."** A resident of California, Helen H. Van Dusen has been interested in aviation ever since observing Glenn Curtiss testing airplanes at North Island in the San Diego Bay.



# "The Satellite Sky" Update/12

These regular updates to **"The Satellite Sky"** chart will enable readers to keep their charts up to date. Additions can be clipped and affixed to the chart at the appropriate altitude.

## New launches

### 90 to 300 MILES

- Cosmos 1984 12-88 PL
- Cosmos 1986 12-88 TT
- Cosmos 1990 1-89 PL
- Cosmos 1993 1-89 TT
- Cosmos 2000 2-89 PL
- Progress 40 2-89 TT

### 300 to 630 MILES

- Cosmos 1985 12-88 PL
- Cosmos1992 1-89 PL

### 630 to 1,250 MILES

- Cosmos 1994-99 2-89 PL

### 6,200 to 13,700 MILES

- Cosmos 1987-88 1-89 TT
- Etalon 1-89 TT

### 21,750 to 22,370 MILES

- Astra 1A 12-88 KOU
- Gorizont 17 1-89 TT
- Intelsat V-A F-15 1-89 KOU
- PRC-25 12-88 XI
- Skynet 4B 12-88 KOU

## Deletions

### 90 to 300 MILES

Cosmos 1815 down 11-15-88
Cosmos 1890 down 12-26-88
Cosmos 1902 down 12-30-88
Cosmos 1981 down 12-8-88
Cosmos 1982 down 12-14-88
Cosmos 1983 down 12-22-88
Soyuz TM-6 down 12-21-88

### 300 to 630 MILES

Offeq 1 down 1-14-89

## Launched but not in orbit

### 90 to 300 MILES

| | | |
|---|---|---|
| Cosmos 1991 USSR photo recon | 1-18-89 | down 2-1-89 |
| Progress 39 USSR research | 12-25-88 | down 2-7-89 |

## Inoperative but still in orbit

### 21,750 to 22,370 MILES

Gorizont 4
Gorizont 8

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# In the Wings . . .


NASA

**Apollo 11: Twenty Years and Counting**—On July 20, 1969, Neil Armstrong made his "giant leap for mankind" from the lunar module *Eagle* to the surface of the moon. To commemorate the 20th anniversary of this monumental event, the June/July 1989 issue of *Air & Space/Smithsonian* will be dedicated to the Apollo 11 mission. It will include:

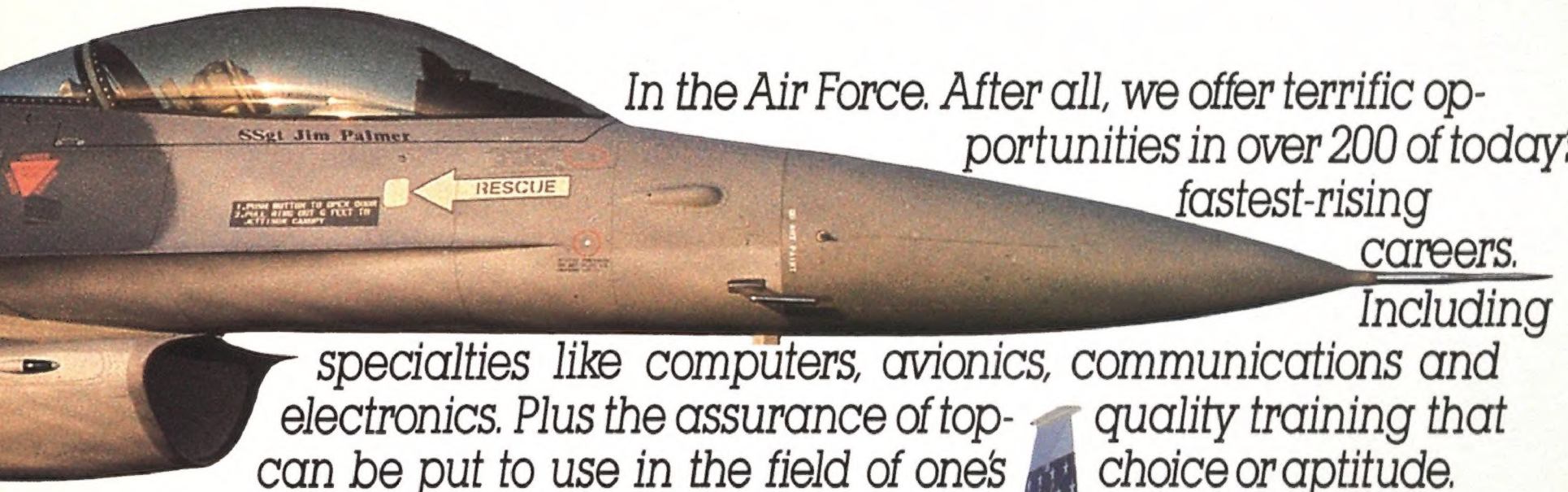
- a full-color poster depicting the liftoff of the huge Saturn V, at the time the most powerful rocket on the planet
- the story of how Project Apollo galvanized a nation
- an analysis of the technological breakthroughs that made the voyage possible
- the cast of thousands that labored behind the scenes in efforts such as the selection of the landing site
- the memories of the media army that invaded Coca Beach, chasing down engineers, astronauts, and launch details
- the reasons why no one has returned to the moon since 1972
- signs of the times: the rest of the news, cartoons, and pop culture that enthralled the nation in the late 1960s

**The C-5A Galaxy**—How can a mere human control a craft that can fit a bowling alley in its belly? Easy, Air Force pilots say—easier than getting all the airplane's systems up and running.

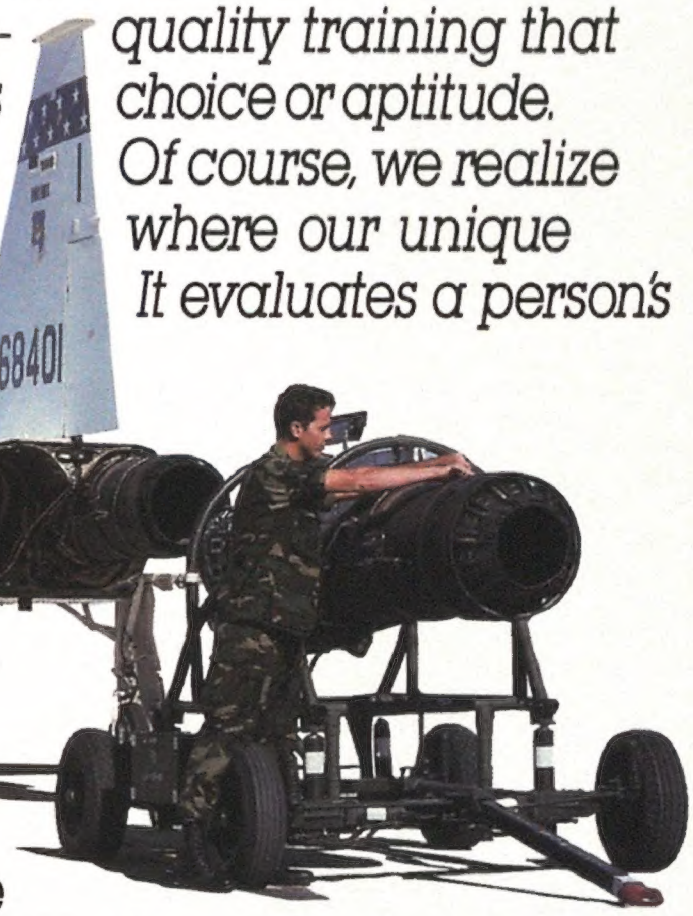
FREDERICK SUTTER/IDI

**Pan Am's Pacific**—"Behind that little dot in the sky," a father told his son as the China Clipper approached Guam, "is the whole world." In 1935 Pan Am forever changed the Pacific islands.

# FOR A LOT OF PEOPLE, THE FUTURE REALLY IS UP IN THE AIR.

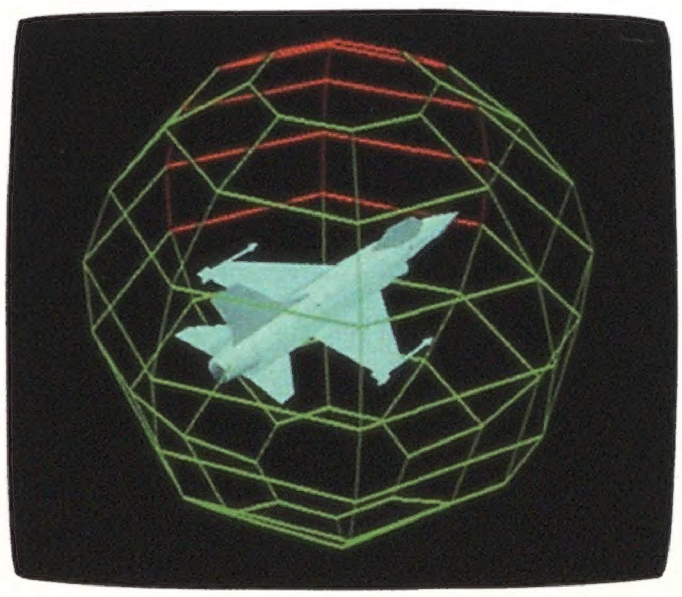



*In the Air Force. After all, we offer terrific opportunities in over 200 of today's fastest-rising careers. Including specialties like computers, avionics, communications and electronics. Plus the assurance of top-quality training that can be put to use in the field of one's choice or aptitude. That's an assurance few employers can match. Of course, we realize not everyone knows what they want to do. That's where our unique screening and orientation process comes in. It evaluates a person's particular strengths and interests, and helps find a career that makes the most of them.*




*Many people discover talents (and job prospects) they never knew they had.*

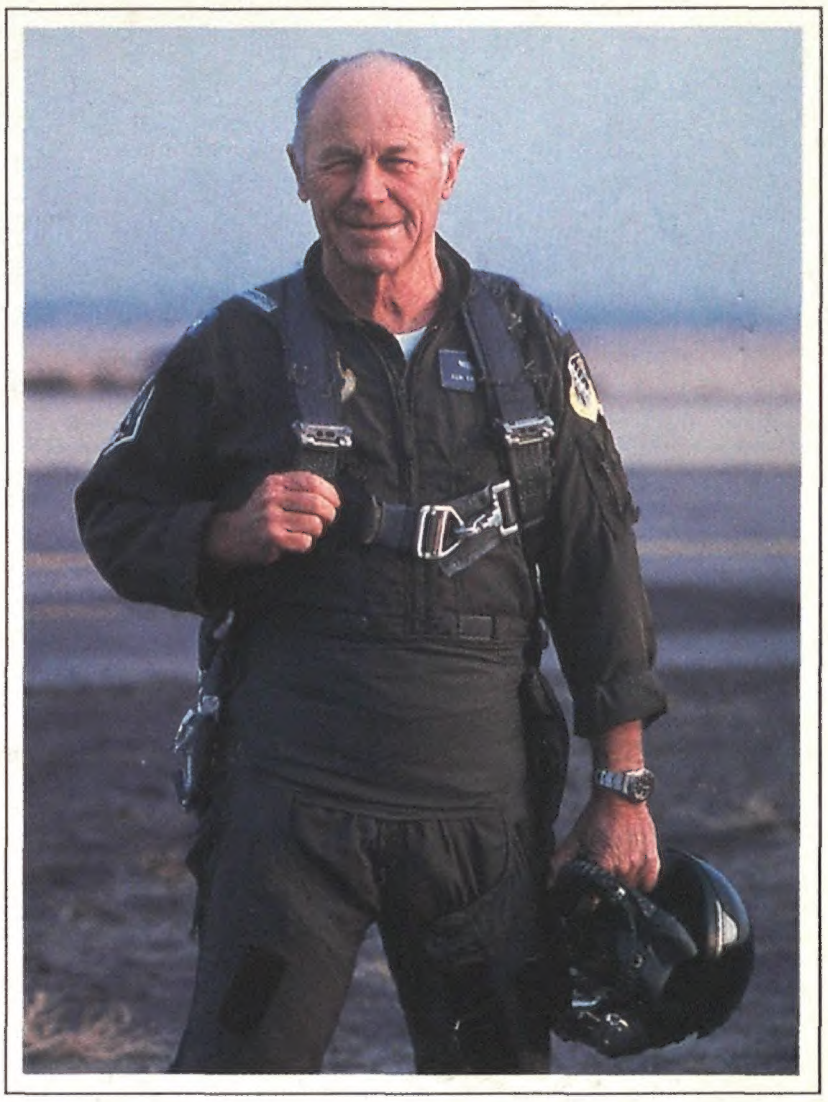
*And should they want to continue their education, we can help there too. We encourage our people to pick up college credits or even an Associate of Applied Science degree in the fully-accredited Community College of the Air Force.*



*So if you know of people whose plans are up in the air, have them call 1-800-423-USAF.*

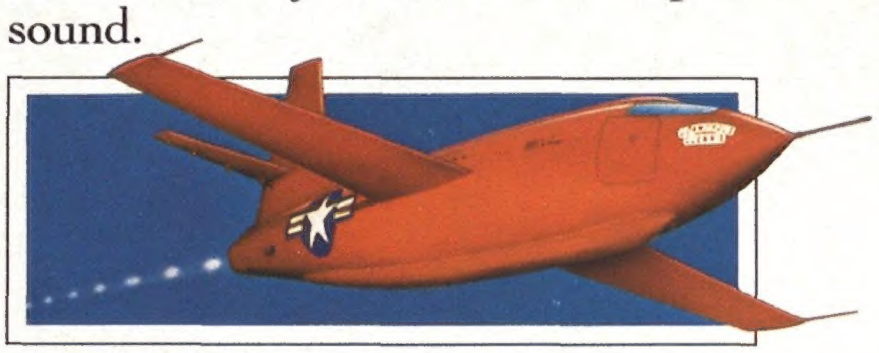
*It could be one of the more uplifting things they ever do.*

**AIM HIGH.**



# To the first man to break the sound barrier, Rolex is essential equipment.

Chuck Yeager first flew when he was 18. Three years later, he was a World War II ace. And at only 24, he became the first man to fly faster than the speed of sound.



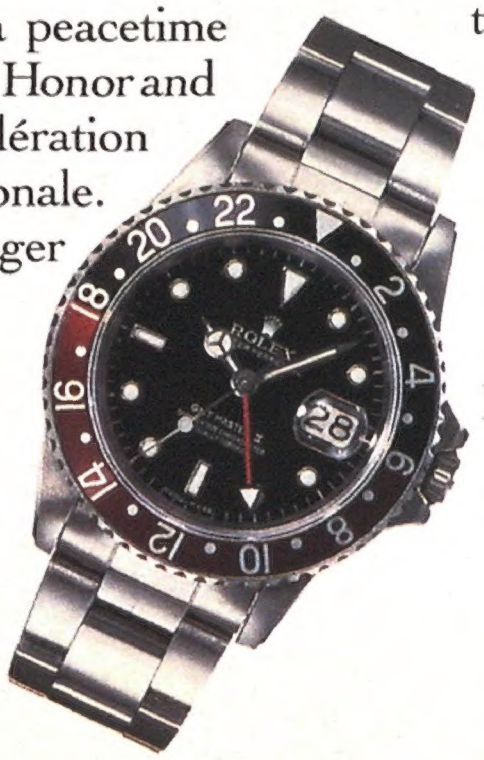
*The Bell X-1, first to fly faster than the speed of sound.*

An uncommon mix of drives and talents contributes to the general's achievements: the grit to press to the outer limits of speed, an insatiable lust for flight, extraordinary eyesight and reflexes, and an instinct for choosing the right equipment. Like the Rolex Oyster that has served him through 4 decades, even on punishing supersonic flights.

Now retired from the military, the general is still a man on the move. He's a consulting test pilot, a lecturer, and a lifelong outdoorsman with a passion for hunting and fishing.

Honors abound for such a man. His many awards include a peacetime Congressional Medal of Honor and the gold medal of the Fédération Aéronautique Internationale.

Today, General Yeager may well be America's most celebrated pilot. His exploits were featured in the Academy Award-winning film *The Right Stuff*. And his autobiography, *Yeager*, became a best-seller.




Keeping one of history's greatest test pilots on schedule takes an extraordinarily tough and reliable timepiece. For over 40 years, Rolex has been Chuck Yeager's choice to meet that challenge. And he ought to know.

*Gold Medal, Fédération Aéronautique Internationale.*

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